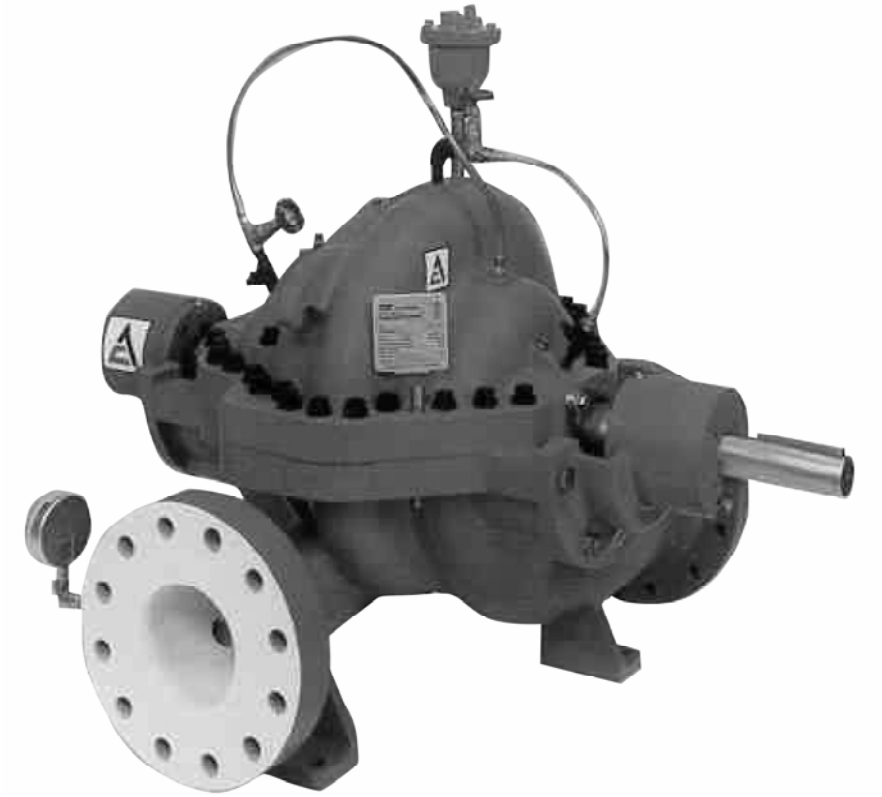
ITT

A-C Fire Pump
Instruction Manual AC2675
REVISION B



8200 Series Base Mounted Centrifugal Fire Pumps

Installation, Operation, and Service Instructions

INSTALLER: PLEASE LEAVE THIS MANUAL FOR THE OWNER'S USE.

Engineered for life

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NOTE

The information contained in this book is intended to assist operating personnel by providing information on the characteristics of the purchased equipment.

It does not relieve the user of their responsibility of using accepted engineering practices in the installation, operation, and maintenance of this equipment.

Any further questions, contact ITT A-C Pump, (847) 966-3700.

DESCRIPTION

The 8200 Series Centrifugal Fire Pumps are framed mounted pumps which feature – high efficiency, rugged construction, compact design, foot mounted volute and regreasable bearings. These features, along with the horizontal split case, make installation, operation and service easy to perform.

OPERATIONAL LIMITS

Unless special provisions have been made for your pump by ITT A-C Fire Pump Systems, the operational limits for 8200 Series Centrifugal Fire Pumps are as follows:

MAXIMUM WORKING PRESSURE

Listed on pump nameplate.

SEAL OPERATING LIMITS

PACKING

PH Limitations 7-9; Temperature Range 0 to +200°F

For use on open or closed systems which require a large amount of makeup water, as well as systems which are subjected to widely varying chemical conditions and solids buildup.

PUMP IDENTIFICATION

There are two identification plates on each pump. The pump rating plate gives identification and rating information. Figure 1 shows an example of a typical Rating Plate.

Permanent records for this pump are referenced by the Serial Number and it must, therefore, be used with all correspondence to order all spare parts and replacement parts. The fourth digit indicates the specific pump on orders for more than one pump. For example, if an order called for six pumps, all pumps would have the same first three sets of digits and the last digit will change to identify each of the six. (e.g. 03-123456-01-01, 03-123456-01-02, etc.)

The frame plate, shown below in Figure 2, gives information concerning the bearings and their lubrication. The inboard and outboard bearing numbers refer to the bearing manufacturer's numbers.

FIGURE 1 – RATING PLATE

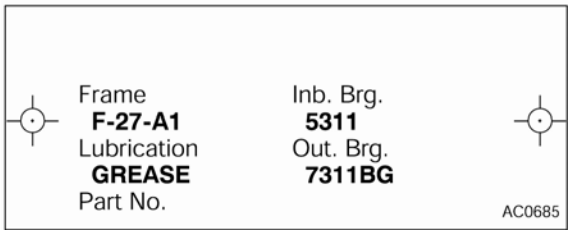


FIGURE 2 – FRAME PLATE

SAFETY INSTRUCTIONS

SAFETY INSTRUCTIONS
This safety alert symbol will be used in this manual and on the pump safety instruction decals to draw attention to safety related instructions. When used the safety alert symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED! FAILURE TO FOLLOW THE INSTRUCTIONS MAY RESULT IN A SAFETY HAZARD.

Your 8200 Series Centrifugal Fire Pump should have the following safety instruction decals displayed. If the decals are missing or illegible contact your local ITT A-C Fire Pump Systems representative for a replacement.

ADDITIONAL SAFETY REQUIREMENTS:

1. Electrical connections to be made by qualified Electrician in accordance with all national, state and local codes.
2. Motor must have properly sized starter with properly sized heaters to provide overload and undervoltage protection.
3. If pump, motor, or piping are operating at extremely high or low temperatures, guarding or insulation is required.
4. The maximum working pressure of the pump is listed on the pump nameplate, do not exceed this pressure.

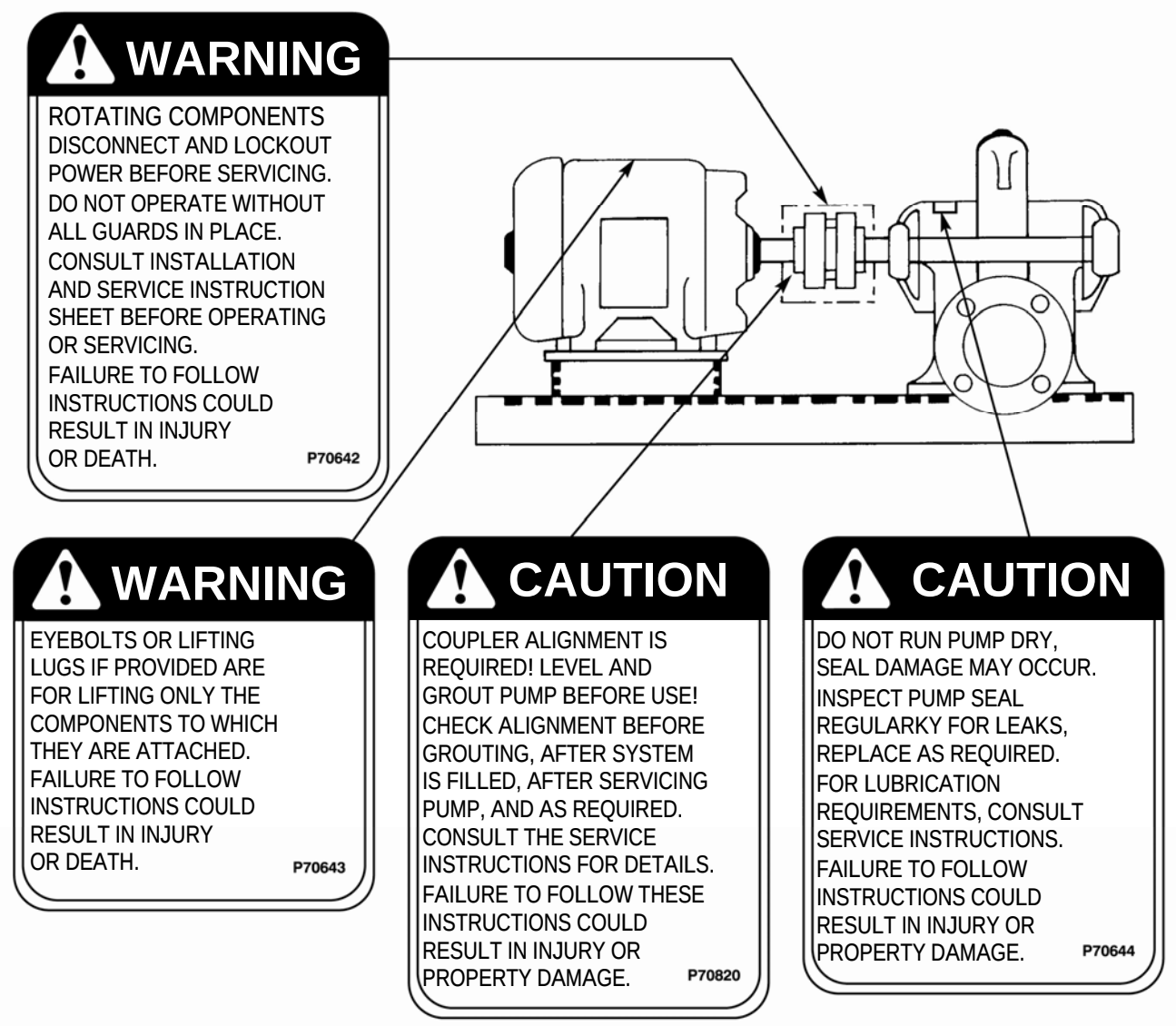


FIGURE 3 - SAFETY INSTRUCTION DECALS

ADDITIONAL SAFETY REQUIREMENTS

ELECTRICAL SAFETY:

WARNING: Electrical Shock Hazard
Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances, and good practices. Failure to follow these instructions could result in serious personal injury or death, and property damage.

WARNING: Electrical Overload Hazard
Three phase motors must have properly sized heaters to provide overload and under voltage protection. Single-phase motors have built-in overload protectors. Failure to follow these instructions could result in serious personal injury or death, and property damage.

THERMAL SAFETY:

WARNING: Extreme Temperature Hazard
If pump, motor, or piping is operating at extremely high or low temperature, guarding or insulation is required. Failure to follow these instructions could result in serious personal injury or death, and property damage.

MECHANICAL SAFETY:

WARNING: Unexpected Startup Hazard
Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, and property damage.

WARNING: Excessive System Pressure Hazard
The maximum working pressure of the pump is listed on the nameplate, do not exceed this pressure. Failure to follow these instructions could result in serious personal injury or death, and property damage.

WARNING: Excessive Pressure Hazard Volumetric Expansion
The heating of water and other fluids causes volumetric expansion. The associated forces may cause failure of system components and release of high temperature fluids. Installing properly sized and located compression tanks and pressure relief valves will prevent this. Failure to follow these instructions could result in serious personal injury or death, and property damage.

INSTALLATION

PUMP LOCATION

Locate the pump so there is sufficient room for inspection, maintenance and service. If the use of a hoist or tackle is needed, allow ample head room.

> **WARNING: Falling Objects Hazard**
> Eyebolts or lifting lugs, if provided, are for lifting only the components to which they are attached. Failure to follow these instructions could result in serious personal injury or death, or property damage.

If lifting base pump is required, use a nylon string, chain, or wire rope, hitch around both bearing supports. If lifting of the entire pump is required, do so with slings placed under the base rails as shown.

Care must be taken to size equipment for unbalanced loads which may exist if the motor is not mounted on the base at the time of lifting. Motor may or may not be mounted at the factory.

Pump, base, and driver assemblies where the base length exceeds 100 inches may not be safe to lift as a complete assembly. Damage to the baseplate may occur. If the driver has been mounted on the baseplate at the factory, it is safe to lift the entire assembly. If the driver has not been mounted at the factory, and the overall baseplate length exceeds 100 inches, do not lift the entire assembly consisting of pump, base, and driver. Instead, lift the pump and baseplate to its final location without the driver. Then mount the driver.

The best pump location for sound and vibration absorption is on a concrete floor with subsoil underneath. If the pump location is overhead, special precautions should be undertaken to reduce possible sound transmission. Consult a sound specialist.

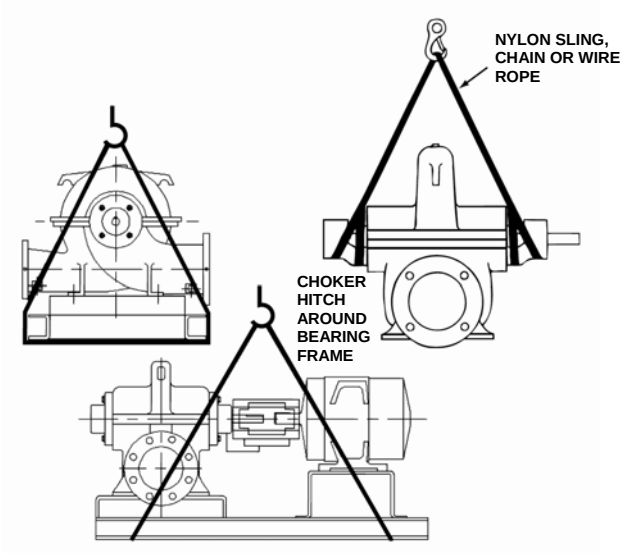


FIGURE 4

If the pump is not on a closed system, it should be placed as near as possible to the source of the liquid supply, and located to permit installation with the fewest number of bends or elbows in the suction pipe.

The installation must be evaluated to determine that the Net Positive Suction Head Available (NPSHA) meets or exceeds the Net Positive Suction Head Required (NPSHR), as stated by the pump performance curve. See page 14 for more details on proper suction piping installation.

RECEIVING PUMP

Check pump for shortages and damage immediately upon arrival. (An absolute must.) Prompt reporting to the carrier's agent with notations made on the freight bill, will expedite satisfactory adjustment by the carrier.

Pumps and drivers normally are shipped from the factory mounted and painted with primer and one finish coat. Couplings may be either completely assembled or have the coupling hubs mounted on the shafts and the connecting members removed. When the connecting members are removed, they will be packaged in a separate container and shipped with the pump or attached to the base plate.

Shafts are in alignment when the unit is shipped; however, due to shipping, the pumps may arrive mis-aligned and, therefore, alignment must be established during installation. ITT AC Fire Pump Systems has determined that proper and correct alignment can only be made by accepted erection practices. Refer to the following paragraphs on

"Foundation," "Base Plate Setting," "Grouting Procedure," "Alignment Procedure" and "Doweling."

TEMPORARY STORAGE

If the pump is not to be installed and operated soon after arrival, store it in a clean, dry place having slow, moderate changes in ambient temperature. Rotate the shaft periodically to coat the bearings with lubricant and to retard oxidation, corrosion, and to reduce the possibility of false brinelling of the bearings.

LOCATION

The pump should be installed as near the suction supply as possible, but no less than five suction diameters (refer to page 14, suction and discharge piping section) with the shortest and most direct suction pipe practical. The total dynamic suction lift (static lift plus friction losses in suction line) should not exceed the limits for which the pump was sold.

The pump must be primed before starting. Whenever possible, the pump should be located below the fluid level to facilitate priming and assure a steady flow of liquid. This condition provides a positive suction head on the pump. It is also possible to prime the pump by pressurizing the suction vessel.

When installing the pump, consider its location in relation to the system to assure that sufficient Net Positive Suction Head (NPSH) at pump suction is provided. Available NPSH must always equal or exceed the required NPSH of the pump.

The pump should be installed with sufficient accessibility for inspection and maintenance. A clear space with ample head room should be allowed for the use of an overhead crane or hoist sufficiently strong to lift the unit.

NOTE: Allow sufficient space to be able to dismantle pump without disturbing the pump inlet and discharge piping.

Select a dry place above the floor level wherever possible. Take care to prevent pump from freezing during cold weather when not in operation. Should the possibility of freezing exist during a shut-down period, the pump should be completely drained, and all passages and pockets where liquid might collect should be blown out with compressed air.

Make sure there is a suitable power source available for the pump driver. If motor driven, electrical characteristics should be identical to those shown on motor data plate.

FOUNDATION

A substantial foundation and footing should be built to suit local conditions. The foundation must be substantial enough to absorb vibration. (Hydraulic Institute Standards recommends the foundation weigh at least five (5) times the weight of the pump unit.) It must form a permanent and rigid support for the baseplate. This is important in maintaining the alignment of the flexibly coupled unit.

The foundation should be poured without interruption to within 1/2 to 1-1/2 inches of the finished height. The top surface of the foundation should be well scored and grooved before the concrete sets; this provides a bonding surface for the grout.

Foundation bolts should be set in concrete as shown in Figure 5. An optional 4-inch long tube around the bolts at the top of the concrete will allow some flexibility in bolt alignment to match the holes in the base plate. Allow enough bolt length for grout, shims, lower base plate flange, nuts and washers. The foundation should be allowed to cure for several days before the base plate is shimmed and grouted.

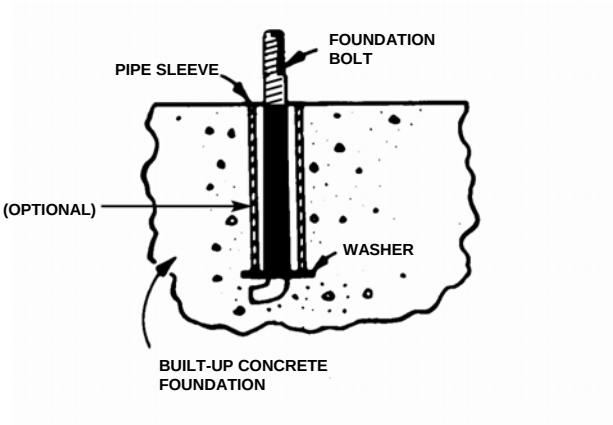


FIGURE 5 – FOUNDATION

BASE PLATE SETTING (BEFORE PIPING)

NOTE: This procedure assumes that a concrete foundation has been prepared with anchor or hold down bolts extending up ready to receive unit. It must be understood that pump and motor have been mounted and rough aligned at the factory. If motor is to be field mounted, consult factory for recommendations. ITT AC Fire Pump Systems cannot assume responsibility for final alignment.

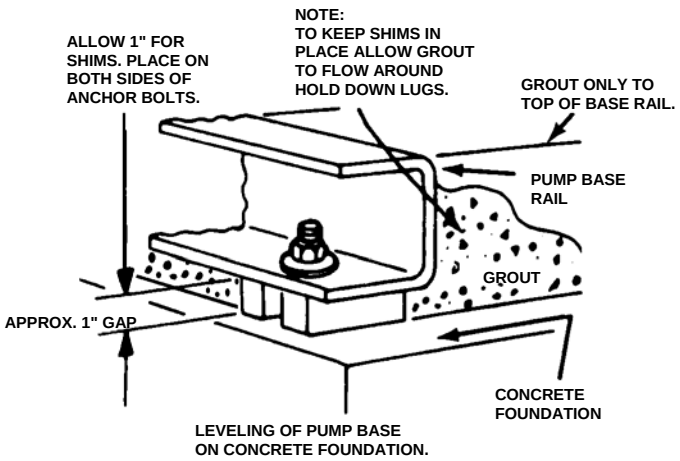

ALLOW 1" FOR SHIMS. PLACE ON BOTH SIDES OF ANCHOR BOLTS.
NOTE: TO KEEP SHIMS IN PLACE ALLOW GROUT TO FLOW AROUND HOLD DOWN LUGS.
GROUT ONLY TO TOP OF BASE RAIL.
PUMP BASE RAIL
GROUT
APPROX. 1" GAP
CONCRETE FOUNDATION
LEVELING OF PUMP BASE ON CONCRETE FOUNDATION.

FIGURE 6 – SETTING BASE PLATE AND GROUTING

a. Use blocks and shims under base for support at anchor bolts and midway between bolts, to position base approximately 1" above the concrete foundation, with studs extending through holes in the base plate.

b. By adding or removing shims under the base, level and plumb the pump shaft and flanges. The base plate does not have to be level.

c. Draw anchor nuts tight against base, and observe pump and motor shafts or coupling hubs for alignment. (Temporarily remove coupling guard for checking alignment.)

d. If alignment needs improvement, add shims or wedges at appropriate positions under base, so that retightening of anchor nuts will shift shafts into closer alignment. Repeat this procedure until a reasonable alignment is reached.

NOTE: Reasonable alignment is defined as that which is mutually agreed upon by pump contractor and the accepting facility (final operator). Final alignment procedures are covered under "Alignment Procedures."

e. Check to make sure the piping can be aligned to the pump flanges without placing pipe strain on either flange.

f. Grout in base plate completely (See "Grouting Procedure") and allow grout to dry thoroughly before attaching piping to pump. (24 hours is sufficient time with approved grouting procedure.)

GROUTING PROCEDURE

Grout compensates for uneven foundation, distributes weight of unit, and prevents shifting. Use an approved, non-shrinking grout, after setting and leveling unit (See Figure 6).

a. Build strong form around the foundation to contain grout.

b. Soak top of concrete foundation thoroughly, then remove surface water.

c. Base plate should be completely filled with grout.

d. After the grout has thoroughly hardened, check the foundation bolts and tighten if necessary.

e. Check the alignment after the foundation bolts are tightened.

f. Approximately 14 days after the grout has been poured or when the grout has thoroughly dried, apply an oil base paint to the exposed edges of the grout to prevent air and moisture from coming in contact with the grout.

SEE ANSI/OSHA COUPLER GUARD REMOVAL/INSTALLATION

(SEE BELOW)

ALIGNMENT PROCEDURE

NOTE: A flexible coupling will only compensate for small amounts of misalignment. Permissible misalignment will vary with the make of coupling. Consult coupling manufacturer's data when in doubt.

Allowances are to be made for thermal expansion during cold alignment, so that the coupling will be aligned at operating temperature. In all cases, a coupling must be in alignment for continuous operation. Even though the coupling may be lubricated, misalignment causes excessive wear, vibration, and bearing loads that result in premature bearing failure and ultimate seizing of the pump. Misalignment can be angular, parallel, or a combination of these, and in the horizontal

and vertical planes. Final alignment should be made by moving and shimming the motor on the base plate, until the coupling hubs are within the recommended tolerances measured in total run-out. All measurements should be taken with the pump and motor foot bolts tightened. The shaft of sleeve bearing motors should be in the center of its mechanical float.

NOTE: Proper alignment is essential for correct pump operation. This should be performed after base plate has been properly set and grout has dried thoroughly according to instructions. Final alignment should be made by shimming driver only. Alignment should be made at operating temperatures.

WARNING: Unexpected Start-up Hazard
Disconnect and lock out power before servicing. Failure to follow these instructions could result in serious personal injury or death and property damage.

ANSI/OSHA COUPLER GUARD REMOVAL/INSTALLATION

WARNING: Unexpected Start-up Hazard
Disconnect and lock out power before servicing. Failure to follow these instructions could result in serious personal injury or death and property damage.

NOTE: Do not spread the inner and outer guards more than necessary for guard removal or installation. Over spreading the guards may alter their fit and appearance.

Removal

a. Remove the two capscrews that hold the outer (motor side) coupler guard to the support bracket(s).

b. Spread the outer guard and pull it off the inner guard.

c. Remove the capscrew that holds the inner guard to the support bracket.

d. Spread the inner guard and pull it over the coupler.

Installation

a. Check coupler alignment before proceeding. Correct if necessary.

b. Spread the inner guard and place it over the coupler.

c. With the inner guard straddling the support bracket, install a capscrew through the hole (or slot) in the support bracket and guard located closest to the pump. Do not tighten the capscrew.

d. Spread the outer guard and place it over the inner guard.

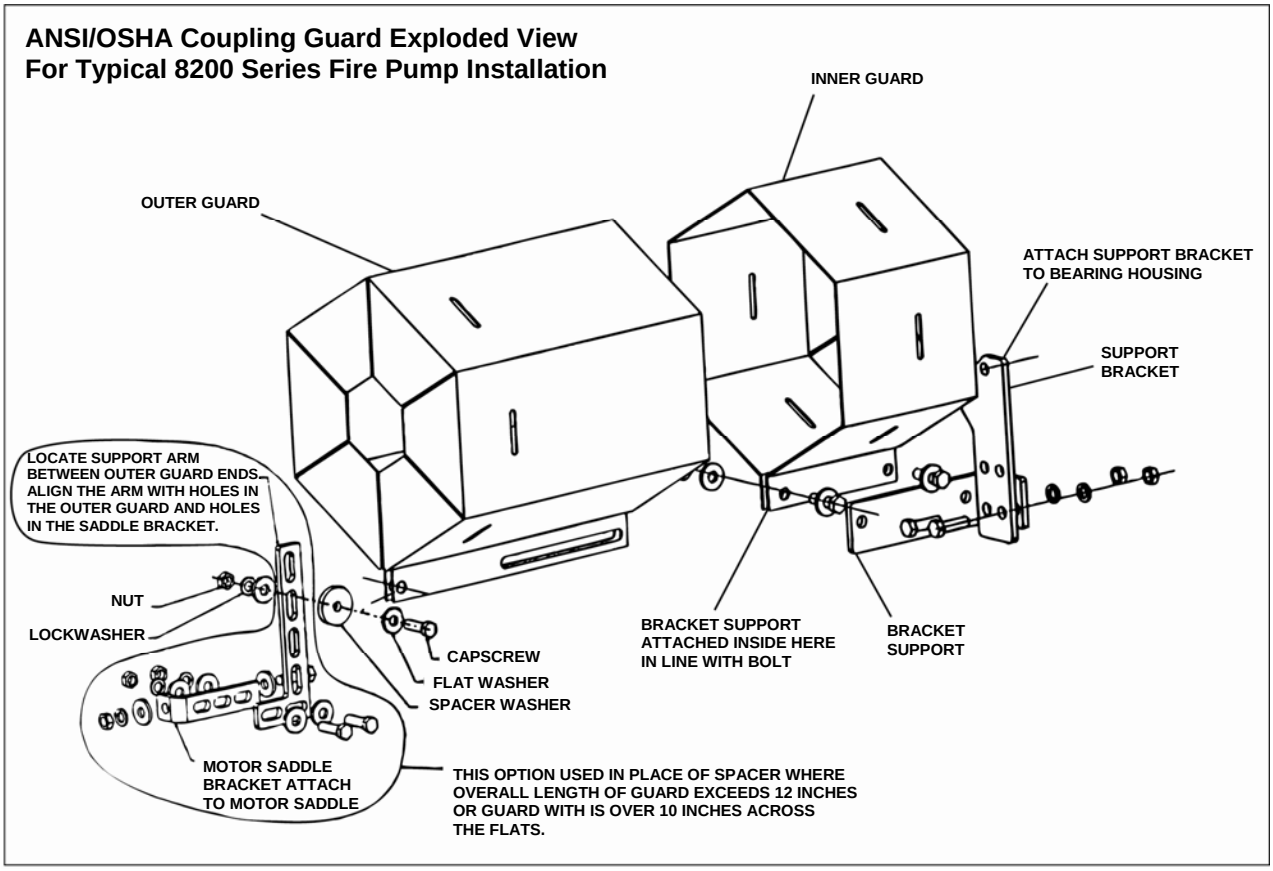
e. Install the outer guard capscrews by following the step stated below which pertains to your particular pump:

   i. *For pumps with a motor saddle support bracket:* Ensure the outer guard is straddling the support arm, and install but do not tighten the two remaining capscrews.

   ii. *For pumps without a motor saddle support bracket:* Insert the spacer washer between the holes located closest to the motor in the outer guard, and install, but do not tighten, the two remaining capscrews.

f. Position the outer guard so it is centered around the shaft, and so there is less than a 1/4" of the motor shaft exposed. On guards that utilize a slotted support bracket, the inner guard will have to be positioned so there is only a 1/4" of the pump shaft exposed.

g. Holding the guard in this position, tighten the three capscrews.


ANSI/OSHA Coupling Guard Exploded View
For Typical 8200 Series Fire Pump Installation
INNER GUARD
OUTER GUARD
ATTACH SUPPORT BRACKET TO BEARING HOUSING
SUPPORT BRACKET
LOCATE SUPPORT ARM BETWEEN OUTER GUARD ENDS. ALIGN THE ARM WITH HOLES IN THE OUTER GUARD AND HOLES IN THE SADDLE BRACKET.
NUT
LOCKWASHER
CAPSCREW
FLAT WASHER
SPACER WASHER
BRACKET SUPPORT ATTACHED INSIDE HERE IN LINE WITH BOLT
BRACKET SUPPORT
MOTOR SADDLE BRACKET ATTACH TO MOTOR SADDLE
THIS OPTION USED IN PLACE OF SPACER WHERE OVERALL LENGTH OF GUARD EXCEEDS 12 INCHES OR GUARD WITH IS OVER 10 INCHES ACROSS THE FLATS.

Method 1 – Straight Edge Alignment for Standard Sleeve Type Coupler with Black Rubber Insert

(See Figure 7A)

Proceed with this method only if satisfied that face and outside diameters of the coupling halves are square and concentric with the coupling borers. If this condition does not exist or elastomeric couplings do not make this method convenient, use Method 2.

1. Check angular misalignment using a micrometer or caliper. Measure from the outside of one flange to the outside of the opposite flange at four points 90° apart. DO NOT ROTATE COUPLER. Misalignment up to 1/64" per inch of coupler radius is permissible.
2. At four points 90° apart (DO NOT ROTATE COUPLER), measure the parallel coupler misalignment by laying a straight edge across one coupler half and measuring the gap between the straight edge and opposite coupler half. Up to a 1/64" gap is permissible.

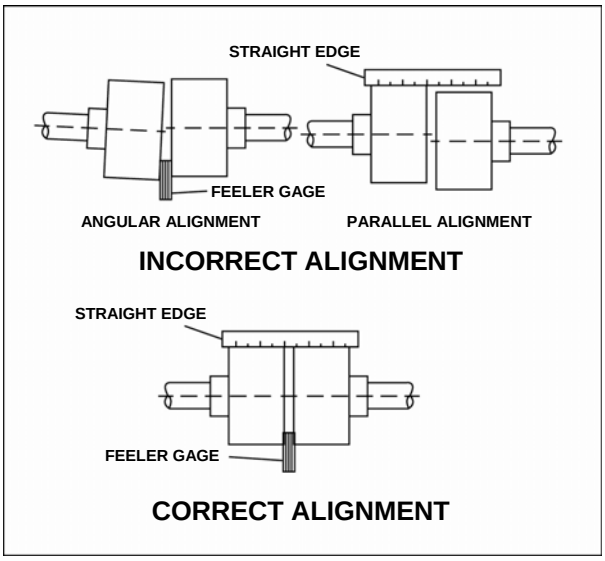


FIGURE 7A – CHECKING ALIGNMENT (METHOD 1)

Method 2 – For Orange Hytrel Insert, 3500 RPM Operation, or All Other Coupler Types Except as Noted Below

(See Figure 7B)

a. Make sure each hub is secured to its respective shaft and that all connecting and/or spacing elements are removed at this time.

b. The gap between the coupling hubs is set by the manufacturer before the units are shipped. However, this dimension should be checked. (Refer to the coupling manufacturer's specifications supplied with the unit.)

c. Scribe index lines on coupling halves as shown in Figure 7B.

d. Mount dial indicator on one hub as shown for parallel alignment. Set dial to zero.

e. Turn both coupling halves so that index lines remain matched. Observe dial reading to see whether driver needs adjustment (See paragraph i below).

f. Mount dial indicator on one hub as shown for angular alignment. Set dial to zero.

g. Turn both coupling halves so that index lines remain matched. Observe dial reading to see whether driver needs adjustment (See paragraph i below).

h. Assemble coupling. Tighten all bolts and set screw(s). It may be necessary to repeat steps c through f for a final check.

i. For single element couplings, a satisfactory parallel misalignment is .004"T.I.R., while a satisfactory angular misalignment is .004"T.I.R. per inch of radius R (See Figure 7B).

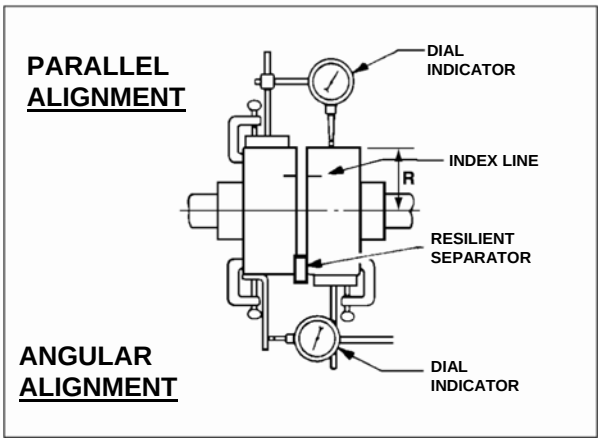


FIGURE 7B – CHECKING ALIGNMENT (METHOD 2)

Grid Couplings

NOTE: The following procedure is intended for mounting and alignment of Rexnord Industries, LLC. and Clarke Fire Protection Products, Inc., Tapered Grid Couplings.

Adequate lubrication is essential for satisfactory operation. Grease supplied by the coupling manufacturer is highly recommended. Other greases to be used should be approved by the coupling manufacturer.

Alignment is shown using a spacer bar and straight edge. Rexnord Industries, LLC. and Clarke Fire Protection Products, Inc. state this practice has been proven for many industrial applications. Superior alignment can be achieved through the use of dial indicators as shown above.

1. Clean all metal parts using non-flammable solvent.
2. Lightly coat seals with coupling vendor supplied grease and place on shafts before mounting shaft hubs.
3. Install keys and mount hubs with flange faces flush with shaft ends or as otherwise specified.
4. Reposition hubs on shafts as required to achieve the required hub gap shown in Figure 7H or otherwise specified. The length of engagement on each shaft should be roughly equal to the shaft diameter.
5. Tighten setscrews.
6. Bring the pump and motor halves of the coupler into approximate height alignment, by placing equal amounts of shims under all the motor feet.
7. Tighten the motor bolts.
8. Use a spacer bar equal in thickness to the gap specified in Figure 7C. Insert bar, as shown below, to same depth at 90° intervals and measure clearance between bar and hub face with feeler gauges. The difference in minimum and maximum measurements must not exceed the angular installation limits shown in Figure 7H.

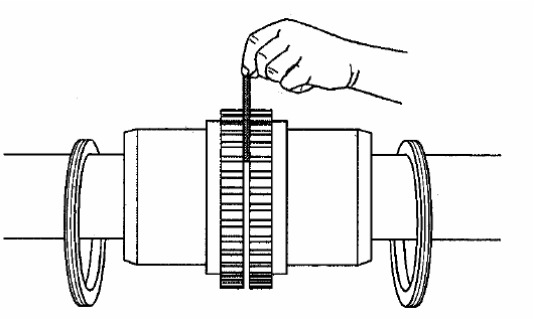


FIGURE 7C – USING SPACER BAR

9. Align so that a straight edge rests within the limits shown in Figure 7D on both hubs as shown below and also at 90° intervals without rotating the coupling. Check with feelers. The clearance must not exceed the PARALLEL OFFSET installation limits specified in Figure 7H.

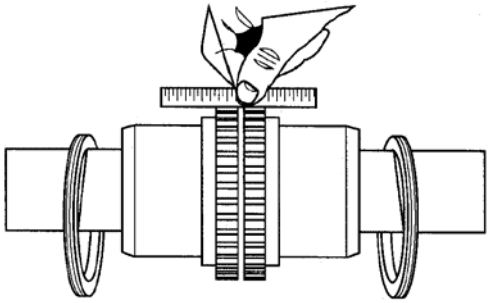


FIGURE 7D – USING STRAIGHT EDGE

10. If adjustment is needed, loosen the motor bolts and add (or remove) an equal amount of shims under each motor foot to align the height. To correct side misalignment, strike the side of the motor foot with a mallet.
11. Tighten the motor bolts and check again. If a correction is made, re-check alignment in all directions. Repeat this process until the desired result is obtained.
12. Pack gap and grooves with coupling vendor supplied grease before inserting grid. When grids are furnished in two or more segments, install them so that all cut ends extend in the same direction as shown below. This will ensure correct grid contact with non-rotating pin in cover halves.
13. Spread the grid slightly to pass over the coupling teeth and seat with a soft mallet.

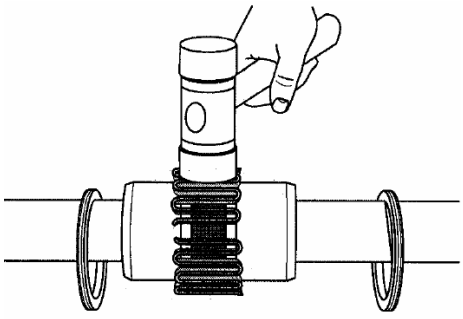


FIGURE 7E – SEATING THE GRID

14. Pack the spaces between and around the grid with as much as coupling vendor supplied grease as possible and wipe off the excess until flush with the top of the grid.
15. Position seals on hubs to line-up with grooves in cover. Position gaskets on flange of lower cover half and assemble covers so that the match marks are on the same side.

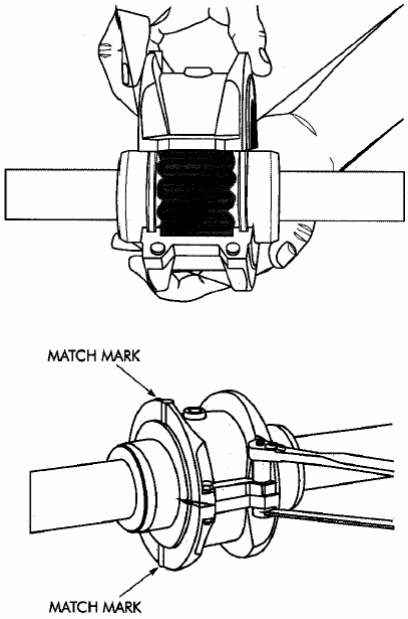


FIGURE 7F – COVER INSTALLATION

16. If the shafts are not horizontal, or coupling is to be used vertically, assemble cover halves with the lug and match mark UP or on the high side. Push gaskets in until they stop against the seals and secure cover halves with fasteners, tightening to torque specified in Figure 7H. Ensure gaskets stay in position during fastener tightening.

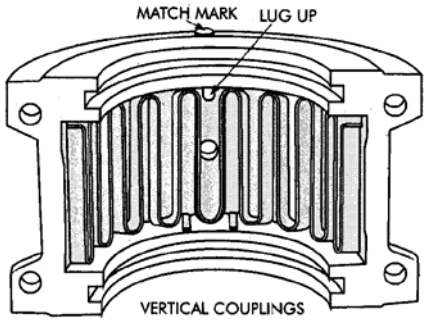


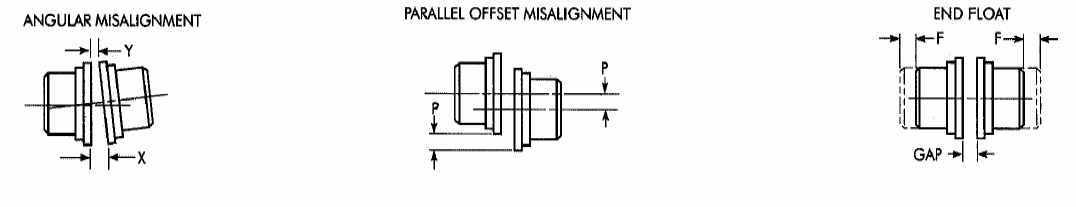
FIGURE 7G – COVER INSTALLATION, VERTICAL POSITION

17. Ensure the lube plugs are installed in the cover.

WARNING: Coupling Failure

Do not operate coupling without proper lubrication

Failure to follow these instructions could result in serious personal injury or death and property damage.



	Installation Limits				Fastener Tightening Torque Values			
Size	Parallel Offset (P)	Angular (x-y)	Hub Gap +/- 10%	End Float Physical Limit (Min) 2xF	Cover Fastener Tightening Torque Values	Flange Type 31 & 35	Maximum Allowable RPM	Lube Wt.
	Max Inch	Max Inch	Inch	Inch	In. Series Fasteners (lb*in)	In. Series Fasteners (lb*in)		lb
1040T	0.006	0.003	0.125	0.211	100	120	3600	0.12
1050T	0.008	0.004	0.125	0.212	200	250	3600	0.15
1060T	0.008	0.005	0.125	0.258	200	440	3600	0.19
1070T	0.008	0.005	0.125	0.259	200	440	1800	0.25
1080T	0.008	0.006	0.125	0.288	200	825	1800	0.38

FIGURE 7H – MISALIGNMENT & FASTENER TORQUE VALUES

Final Alignment

Final alignment cannot be accomplished until the pump has been operated initially for a sufficient length of time to attain operating temperature. When normal operating temperature has been attained, secure the pump to re-check alignment and compensate for temperature accordingly. See Alignment Section.

WARNING: Rotating Components Hazard

Do not operate pump without all guards in place. Failure to follow these instructions could result in serious personal injury or death and property damage.

WARNING: Coupling Failure

Do not operate pump with coupling out of alignment. Ensure final coupling alignment is within the values stated above or according to the coupling manufacturer's instructions. Coupling, pump, or driver failure may occur.

Failure to follow these instructions could result in serious personal injury or death and property damage.

OPTIONAL Alignment Procedure

If desired, the pump and motor feet can be doweled to the base after final alignment is complete. This should not be done until the unit has been run for a sufficient length of

time and alignment is within the tolerance. See Doweling Section.

CAUTION: Extreme Temperature and/or Flying Debris Hazard

Eye protection and gloves required. Failure to follow these instructions could result in property damage and/or moderate personal injury.

NOTE: Pump may have been doweled to base at factory.

DOWELING

Dowel the pump and driving unit as follows:

a. Drill holes through diagonally opposite feet and into the base. Holes must be of a diameter 1/64 inch less than the diameter of the dowel pins. Clean out the chips.

b. Ream the holes in feet and base to the proper diameter for the pins (light push fit). Clean out the chips.

c. Insert pins to be approximately flush with feet.

SUCTION AND DISCHARGE PIPING

General

When installing the pump piping, be sure to observe the following precautions:

Piping should always be run to the pump.

Do not move pump to pipe. This could make final alignment impossible.

Both the suction and discharge piping should be supported independently near the pump and properly aligned, so that no strain is transmitted to the pump when the flange bolts are tightened. Use pipe hangers or other supports at necessary intervals to provide support. When expansion joints are used in the piping system, they must be installed beyond the piping supports closest to the pump. Tie bolts should be used with expansion joints to prevent pipe strain. Do not install expansion joints next to the pump or in any way that would cause a strain on the pump resulting from system pressure changes. It is usually advisable to increase the size of both suction and discharge pipes at the pump connections to decrease the loss of head from friction.

Install piping as straight as possible, avoiding unnecessary bends. Where necessary, use 45-degree or long sweep 90-degree fitting to decrease friction losses.

Make sure that all piping joints are air-tight.

Where flanged joints are used, assure that inside diameters match properly.

Remove burrs and sharp edges when making up joints.

Do not “spring” piping when making any connections.

Provide for pipe expansion when hot fluids are to be pumped.

Suction Piping

When installing the suction piping, observe the following precautions. Figure 8 shows some correct and incorrect suction piping arrangements.

The sizing and installation of the suction piping is extremely important. It must be selected and installed so that pressure losses are minimized and sufficient liquid will flow into the pump when started and operated. Many NPSH (Net Positive Suction Head) problems can be attributed directly to improper suction piping systems.

Friction losses caused by undersized suction piping can increase the fluid’s velocity into the pump. As recommended by the Hydraulic Institute Standard ANSI/HI 1.1-1.5-1994, suction pipe velocity should not exceed the velocity in the pump suction nozzle. In some situations pipe velocity may need to be further reduced to satisfy pump NPSH requirements and to control suction line losses. Pipe friction can be reduced by using pipes that are one to two sizes larger than the pump suction nozzle in order to maintain pipe velocities less than 5 feet/second.

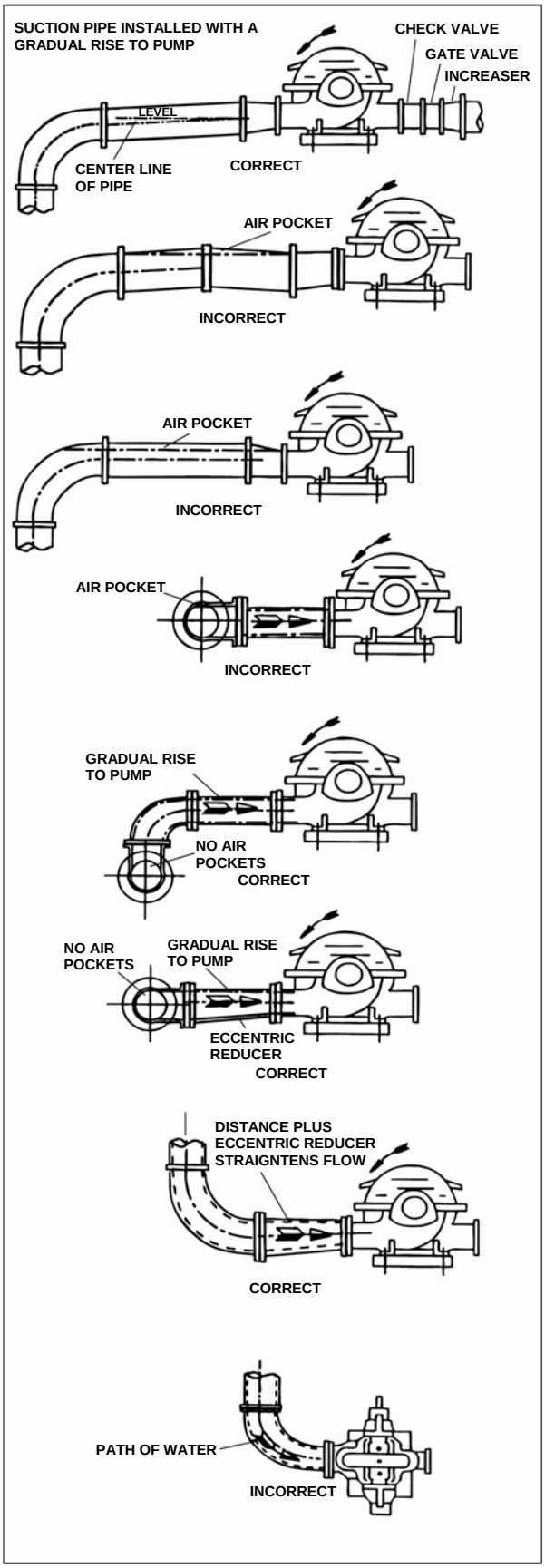


FIGURE 8 – SUCTION INSTALLATIONS (PIPING SUPPORTS NOT SHOWN)

Suction piping should be short in length, as direct as possible, and never smaller in diameter than the pump suction opening. A minimum of ten (10) pipe diameters between any elbow or tee and the pump should be allowed. If a long suction pipe is required, it should be one or two sizes larger than the suction opening, depending on its length.

CAUTION:
An elbow should not be used directly before the suction of a double suction pump if its plane is parallel to the pump shaft. This can cause an excessive axial load or NPSH problems in the pump due to an uneven flow distribution. If there is no other choice, the elbow should have straightening vanes to help evenly distribute the flow. Failure to follow these instructions could result in injury or property damage.

Eccentric reducers should be limited to one pipe size reduction each to avoid excessive turbulence and noise. They should be of the conical type. Contour reducers are not recommended.

When operating on a suction lift, the suction pipe should slope upward to the pump nozzle. A horizontal suction line must have a gradual rise to the pump. Any high point in the pipe can become filled with air and prevent proper operation of the pump. When reducing the piping to the suction opening diameter, use an eccentric reducer with the eccentric side down to avoid air pockets.

NOTE: When operating on suction lift never use a concentric reducer in a horizontal suction line, as it tends to form an air pocket in the top of the re-ducer and the pipe.

To facilitate cleaning pump liquid passage without dismantling pump, a short section of pipe (Dutchman or spool piece) so designed that it can be readily dropped out of the line can be installed adjacent to the suction flange. With this arrangement, any matter clogging the impeller is accessible by removing the nozzle (or pipe section).

Valves in Suction Piping

When installing valves in the suction piping, observe the following precautions:

a. If the pump is operating under static suction lift conditions, a foot valve may be installed in the suction line to avoid the necessity of priming each time the pump is started. This valve should be of the flapper type, rather than the multiple

spring type, sized to avoid excessive friction in the suction line. (Under all other conditions, a check valve, if used, should be installed in the discharge line.) (See "Valves in Discharge Piping")

b. When foot valves are used, or where there are other possibilities of "water hammer," close the discharge valve slowly before shutting down the pump.

c. Where two or more pumps are connected to the same suction line, install gate valves so that any pump can be isolated from the line. Gate valves should be installed on the suction side of all pumps with a positive pressure for maintenance purposes. Install gate valves with stems horizontal to avoid air pockets. Globe valves should not be used, particularly where NPSH is critical.

d. The pump must never be throttled by the use of a valve on the suction side of the pump. Suction valves should be used only to isolate the pump or maintenance purposes, and should always be installed in positions to avoid air pockets.

e. A pump drain valve should be installed in the suction piping between the isolation valve and the pump.

Discharge Piping

If the discharge piping is short, the pipe diameter can be the same as the discharge opening. If the piping is long, pipe diameter should be one or two sizes larger than the discharge opening. On long horizontal runs, it is desirable to maintain as even a grade as possible. Avoid high spots, such as loops, which will collect air and throttle the system or lead to erratic pumping.

Valves in Discharge Piping

A slow closing check valve and an isolating gate valve should be installed in the discharge line. The check valve (triple duty valve), placed between pump and gate valve, protects the pump from excessive back pressure, and prevents liquid from running back through the pump in case of power failure. The gate valve is used in priming and starting, and when shutting the pump down.

Pressure Gauges

Properly sized pressure gauges should be installed in both the suction and discharge nozzles in the gauge taps provided. The gauges will enable the operator to easily observe the operation of the pump, and also determine if the pump is operating in conformance with the performance curve. If cavitation, vapor binding, or other unstable operation should occur, widely fluctuating discharge pressure will be noted.

Pump Insulation

On chilled water applications most pumps are insulated. As part of this practice, the pump bearing housings should not be insulated since this would tend to "trap" heat inside the housing. This could lead to increased bearing temperatures and premature bearing failures.

STUFFING BOX LUBRICATION

Contaminants in the pumped liquid must not enter the stuffing box. These contaminants may cause severe abrasion or corrosion of the shaft, or shaft sleeve, and rapid packing deterioration; they can even plug the stuffing box flushing and lubrication system. The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing or seal. It is important to establish the optimum flushing pressure that will keep contaminants from the stuffing box cavity. If this pressure is too low, fluid being pumped may enter the stuffing box. If the pressure is too high, excessive packing wear may result; and extreme heat may develop in the shaft causing higher bearing temperatures. The most desirable condition, therefore, is to use a seal water pressure 15-20 psig above the maximum stuffing box pressure.

PACKING

Standard pumps are normally packed before shipment. If the pump is installed within 60 days after shipment, the packing will be in good condition with a sufficient supply of lubrication. If the pump is stored for a longer period, it may be necessary to repack the stuffing box. In all cases, however, inspect the packing before the pump is started.

NOTE: Packing adjustment is covered in the MAINTENANCE section of this manual.

On some applications, it is possible to use internal liquid lubrication (pumped liquid) to lubricate packing. Only when all of the following conditions prevail, can this be done:

1. Liquid is clean, free from sediment and chemical precipitation and is compatible with seal materials.
2. Temperature is above 32°F and below 160°F.
3. Suction pressure is below 75 psig.
4. Lubrication (pumped liquid) has lubricating qualities.
5. Liquid is non-toxic and non-volatile.

When the liquid being pumped contains solids or is otherwise not compatible with packing materials, an outside supply of seal liquid should be furnished. In general, external-injection liquid (from an outside source) is required when any of the above conditions cannot be met.

The standard stuffing box consists of rings of packing (see assembly section for number of rings), a seal cage, a bushing and a gland. A shaft sleeve which extends through the box and under the gland is provided to protect the shaft.

A tapped hole is supplied in the stuffing box directly over the seal cage to introduce a clean, clear sealing medium. The stuffing box must, at all times, be supplied with sealing liquid at a high enough pressure to keep the box free from foreign matter, which would quickly destroy the packing and score the shaft sleeve.

Only a sufficient volume of sealing liquid to create a definite direction of flow from the stuffing box inward to the pump casing is required, but the pressure is important. Apply seal water at a rate of approximately .25 GPM at a pressure approximately 15 to 20 psig above the suction pressure. (Approximately one (1) drop per second.)

One recommended method to minimize error in regulating flushing water is a “Controlled Pressure System” (Figure 9). It is important to set the pressure reducing valve adjusted to a value slightly exceeding the maximum stuffing box operating pressure (assuming it is reasonably constant). A flow indicating device will detect a failing of the bottom packing rings allowing leakage in the pump.

External sealing liquid should be adjusted to the point where the packing runs only slightly warm, with a very slow drip from the stuffing box. Excess pressure from an external source can be very destructive to packing.

More pressure is required, however, for abrasive slurries than for clear liquids. Examination of the leakage will indicate whether to increase or decrease external pressure. If slurry is present in the leakage, increase the pressure until only clear liquid drips from the box. If the drippage is corrosive or harmful to personnel, it should be collected and piped away.

A common error is to open the external piping valve wide and then control the drippage by tightening the packing gland. A combination of both adjustments is essential to arrive at the optimum condition. The life of packing and sleeve depends on careful control more than any other factor.

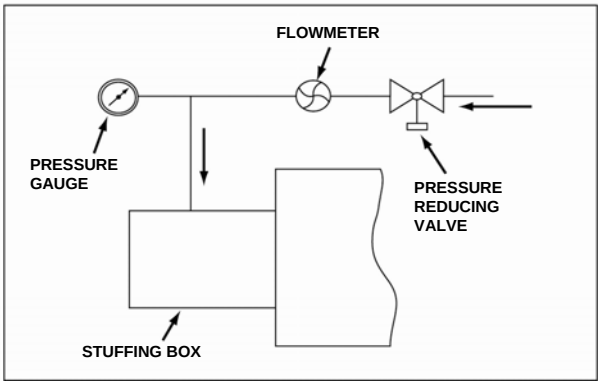


FIGURE 9 – CONTROLLED PRESSURE SYSTEM

OPERATION

WARNING: Unexpected Startup Hazard
Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

WARNING: Electrical Shock Hazard
Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances, and good practices. Failure to follow these instructions could result in serious personal injury or death, or property damage.

PRE-START CHECKS

Before initial start of the pump, make the following inspections:

a. Check alignment between pump and motor.

b. Check all connections to motor and starting device with wiring diagram. Check voltage, phase, and frequency on motor nameplate with line circuit.

c. Check suction and discharge piping and pressure gauges for proper operation.

d. Check impeller adjustment, see specific section for proper adjustment.

e. Turn rotating element by hand to assure that it rotates freely.

f. Check driver lubrication.

g. Assure that pump bearings are properly lubricated.

h. Assure that coupling is properly lubricated, if required.

i. Assure that pump is full of liquid (See Priming) and all valves are properly set and operational, with the discharge valve closed, and the suction valve open.

j. Check rotation. Be sure that the drive operates in the direction indicated by the arrow on the pump casing as serious damage can result if the pump is operated with incorrect rotation. Check rotation each time the motor leads have been disconnected.

WARNING: Rotating Components Hazard
Do not operate pump without all guards in place. Failure to follow these instructions could result in serious personal injury or death and property damage.

CAUTION: Seal Damage Hazard
Do not run pump dry, seal damage may occur. Failure to follow these instructions could result in property damage and/or moderate personal injury.

PRIMING

If the pump is installed with a positive head on the suction, it can be primed by opening the suction and vent valve and allowing the liquid to enter the casing.

If the pump is installed with a suction lift, priming must be done by other methods such as foot valves, ejectors, or by manually filling the casing and suction line.

WARNING: Rotating Components Hazard
Do not operate pump without all guards in place. Failure to follow these instructions could result in serious personal injury or death and property damage.

STARTING

a. Close drain valves and valve in discharge line.

b. Open fully all valves in the suction line.

c. Prime the pump.

NOTE: If the pump does not prime properly, or loses prime during start-up, it should be shutdown and the condition corrected before the procedure is repeated.

d. When the pump is operating at full speed, open the discharge valve slowly. This should be done promptly after start-up to prevent damage to pump by operating at zero flow.

OPERATING CHECKS

a. Check the pump and piping to assure that there are no leaks.

b. Check and record pressure gauge readings for future reference.

c. Check and record voltage, amperage per phase, and kw if an indicating wattmeter is available.

d. Check bearings for lubrication and temperature. Normal temperature is 180° maximum.

e. Make all pump output adjustments with the discharge line.

CAUTION: Cavitation Damage Hazard
Do not throttle the suction line to adjust the pump output. Failure to follow these instructions could result in property damage and/or moderate personal injury.

FREEZING PROTECTION

Pumps that are shut down during freezing conditions should be protected by one of the following methods.

a. Drain the pump; remove all liquids from the casing.

b. Keep fluid moving in the pump and insulate or heat the pump to prevent freezing.

CAUTION: Bearing/Seal Damage Hazard
Do not let heated pump temperature rise above 150°F. Failure to follow these instructions could result in property damage and/or moderate personal injury.

FIELD TESTING

A typical performance curve for a specific pump can be obtained from ITT A-C Fire Pump Systems. This can be used in conjunction with a field test, if one is required. All ITT A-C Fire Pump Systems tests and curves are based on the *Hydraulic Institute Standards*. Any field test must be conducted according to these Standards.

Unless otherwise specifically agreed, all capacity, head, and efficiencies are based on shop tests when handling clear, cold, fresh water at a temperature not over 85°F.

Appendix “C” (Pages 36-37) contains a field test report sheet and some useful equations which can be used when conducting a field test.

MAINTENANCE

GENERAL MAINTENANCE

Operating conditions vary so widely that to recommend one schedule of preventative maintenance for all centrifugal pumps is not possible. Yet some sort of regular inspection must be planned and followed. We suggest a permanent record be kept of the periodic inspections and maintenance performed on your pump. This recognition of maintenance procedure will keep your pump in good working condition, and prevent costly breakdown.

One of the best rules to follow in the proper maintenance of your centrifugal pump is to keep a record of actual operating hours. Then, after a predetermined period of operation has elapsed, the pump should be given a thorough inspection. The length of this operating period will vary with different applications, and can only be determined from experience. New equipment, however, should be examined after a relatively short period of operation. The next inspection period can be lengthened somewhat. This system can be followed until a maximum period of operation is reached which should be considered the operating schedule between inspections.

MAINTENANCE OF PUMP DUE TO FLOOD DAMAGE

WARNING: Unexpected Startup Hazard
Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

WARNING: Electrical Shock Hazard
Electrical connections to be made by a qualified electrician in accordance will all applicable codes, ordinances, and good practices. Failure to follow these instructions could result in serious personal injury or death, or property damage.

The servicing of centrifugal pumps after a flooded condition is a comparatively simple matter under normal conditions.

Bearings are a primary concern on pumping units. First, dismantle the bearings; clean and inspect them for any rusted or badly worn surfaces. If bearings are free from rust and wear, reassemble and relubricate them with one of the recommended pump lubricants. Depending on the

length of time the pump has remained in the flooded area, it is unlikely that bearing replacement is necessary; however, in the event that rust or worn surfaces appear, it may be necessary to replace the bearings.

Next, inspect the stuffing box, and clean out any foreign matter that might clog the box. Mechanical seals should be cleaned and thoroughly flushed.

Couplings should be dismantled and thoroughly cleaned.

Any pump that is properly sealed at all joints and connected to both the suction and discharge should exclude outside liquid. Therefore, it should not be necessary to go beyond the bearings, stuffing box, and coupling when servicing the pump.

BEARING LUBRICATION – GREASE

Grease lubricated ball bearings are packed with grease at the factory and ordinarily will require no attention before starting, provided the pump has been stored in a clean, dry place prior to its first operation. The bearings should be watched the first hour or so after the pump has been started to see that they are operating properly.

The importance of proper lubrication cannot be over emphasized. It is difficult to say how often a bearing should be greased, since that depends on the conditions of operation. It is well to add one ounce of grease at regular intervals, but it is equally important to avoid adding too much grease. For average operating conditions, it is recommended that 1 oz. of grease be added at intervals of three to six months, and only clean grease be used. It is always best if unit can be stopped while grease is added to avoid overloading.

NOTE: Excess grease is the most common cause of over-heating.

A lithium based NLGI-2 grade grease should be used for lubricating bearings where the ambient temperature is above -20°F. Grease lubricated bearings are packed at the factory with Shell Alvania No 2. Other recommended greases are Texaco Multifak No. 2 and Mobilux No. 2 grease.

Greases made from animal or vegetable oils are not recommended due to the danger of deterioration and forming of acid. Do not use graphite. Use of an ISO VG 100 mineral base oil with rust and oxidation inhibitors is recommended.

The maximum desirable operating temperature for ball bearings is 180°F. Should the temperature of the bearing frame rise above 180°F, the pump should be shut down to determine the cause.

PACKING SEAL

When a pump with packing is first started it is advisable to have the packing slightly loose without causing an air leak. As the pump runs in, gradually tighten the gland bolts evenly. The gland should never be drawn to the point where packing is compressed too tightly and no leakage occurs. This will cause the packing to burn, score the shaft sleeve and prevent liquid from circulating through the stuffing box cooling the package.

NOTE: Eccentric run-out of the shaft or sleeve through the packing could result in excessive leakage that cannot be compensated for. Correction of this defect requires shaft and/or sleeve replacement. Packing should be checked frequently and replaced as service indicates. Six months might be a reasonable expected life, depending on the operating conditions.

CLEANING WITHOUT DISMANTLING PUMP

A short section of pipe so designed that it can be readily dropped out of the line can be installed adjacent to the suction flange. With this arrangement, any matter clogging the impeller is accessible by removing the pipe section.

If the pump cannot be freed of clogging after the above methods have been tried, dismantle the unit as previously described to locate the trouble.

MAINTENANCE TIME TABLE

EVERY MONTH	Check bearing temperature with a thermometer, not by hand. If bearings are running hot (over 180°F), it may be the result of too much lubricant. If changing the lubricant does not correct the condition, disassembly and inspect the bearings. Lip seals bearing on the shaft may also cause the housing to run hot. Lubricate lip seals to correct.
EVERY 3 MONTHS	Check grease lubricated bearings for saponification. This condition is usually caused by the infiltration of water or other fluid past the bearing shaft seals and can be noticed immediately upon inspection, since it gives the grease a whitish color. Wash out the bearings with a clean industrial solvent and replace the grease with the proper type as recommended.
EVERY 6 MONTHS	Check the packing and replace if necessary. Use the grade recommended. Be sure the seal cages are centered in the stuffing box at the entrance of the stuffing box piping connection. Take vibration readings on the bearing housings. Compare the readings with the last set of readings to check for possible pump component failure (e.g. bearings) Check shaft or shaft sleeve for scoring. Scoring accelerates packing wear. Check alignment of pump and motor. Shim up units if necessary. If misalignment reoccurs frequently, inspect the entire piping system. Unbolt piping at suction and discharge flanges to see if it springs away, thereby indicating strain on the casing. Inspect all piping supports for soundness and effective support of load. Correct as necessary.
EVERY YEAR	Remove the upper half of the casing. Inspect the pump thoroughly for wear, and order replacement parts if necessary. Check wear ring clearances. Replace when clearances become three (3) times their normal clearance or when a significant decrease in discharge pressure for the same flow rate is observed. See Engineering Data Section for standard clearances. Remove any deposit or scaling. Clean out stuffing box piping. Measure total dynamic suction and discharge head as a test of pump performance and pipe condition. Record the figures and compare them with the figures of the last test. This is important, especially where the fluid being pumped tends to form a deposit on internal surfaces. Inspect foot valves and check valves, especially the check valve which safeguards against water hammer when the pump stops. A faulty foot or check valve will reflect also in poor performance of the pump while in operation.

NOTE: *The above time table is based on the assumption that after start-up, the unit had been constantly monitored and such a schedule was found to be consistent with operation, as shown by stable readings. Extreme or unusual applications or conditions should be taken into consideration when establishing the maintenance intervals.*

TROUBLE SHOOTING

Between regular maintenance inspections, be alert for signs of motor or pump trouble. Common symptoms are listed below. Correct any trouble immediately and AVOID COSTLY REPAIR AND SHUTDOWN.

CAUSES	CURES
No Liquid Delivered	
1. Lack of prime.	Fill pump and suction pipe completely with liquid.
2. Loss of prime.	Check for leaks in suction pipe joints and fittings; vent casing to remove accumulated air. Check mechanical seal or packing.
3. Suction lift too high (a negative suction gauge reading).	If there is no obstruction at inlet and suction valves are open, check for pipe friction losses. However, static lift may be too great. Measure with mercury column or vacuum gauge while pump operates. If static lift is too high, liquid to be pumped must be raised or pump lowered.
4. System static head too high.	Check with factory to see if a larger impeller can be used; otherwise, cut pipe losses or increase speed – or both, as needed. But be careful not to overload driver by more than the service factor.
5. Speed too low.	Check whether motor is directly across-the-line and receiving full voltage. Frequency may be too low. Motor may have an open phase.
6. Wrong direction of rotation.	Check motor rotation with directional arrow on pump casing. If rotation is correct with arrow, check the relationship of the impeller with casing. (This will require removing casing upper half.) See Figure 10 on page 25.
7. No rotation.	Check power, coupling, line shaft and shaft keys.
8. Impeller loose on shaft.	Check key, locknut and set screws.
9. Impeller completely plugged.	Dismantle pump and clean impeller.
10. System head or required discharge head too high.	Check pipe friction losses. Large piping may correct condition. Check that valves are wide open.
Not Enough Liquid Delivered	
11. Air leaks in suction piping.	If liquid pumped is water or other non-explosive and explosive gas or dust is not present, test flanges for leakage with flame or match. For such liquids as gasoline, suction line can be tested by shutting off or plugging inlet and putting line under pressure. A gauge will indicate a leak with a drop of pressure.
12. Air leaks in stuffing box.	Replace packing and sleeves if appropriate or increase seal lubricant pressure to above atmosphere.
13. Speed too low.	See item 5.
14. Discharge head too high.	See item 10.
15. Suction lift too large.	See item 3.

TROUBLE SHOOTING (CONT.)

CAUSES	CURES
16. Impeller partially plugged.	See item 9.
17. Cavitation; insufficient NPSHA (Net Positive Suction Head Available).	a. Increase positive suction head on pump by lowering pump or increasing suction pipe and fittings size.
	b. Sub-cool suction piping at inlet to lower entering liquid temperature.
	c. Pressurize suction vessel.
18. Defective impeller.	Inspect impeller, bearings and shaft. Replace if damaged or vane sections badly eroded.
19. Foot valve too small or partially obstructed.	Area through ports of valve should be at least as large as area of suction pipe (preferably 1.5 times). If strainer is used, net clear area should be 3 to 4 times area of suction pipe.
20. Suction inlet not immersed deep enough.	If inlet cannot be lowered or if eddies through which air is sucked persist when it is lowered, chain a board to suction pipe. It will be drawn into eddies, smothering the vortex.
21. Wrong direction of rotation.	Symptoms are an overloaded driver and about one third rated capacity from pump. Compare rotation of motor with directional arrow on pump casing. If rotation is correct with arrow, impeller may have to be turned 180°. (See CHANGING ROTATION.)
22. System head too high.	See item 4.
23. Defective mechanical seal.	Repair or replace seal.
Not Enough Pressure	
24. Speed too low.	See item 5.
25. Air leaks in suction piping or stuffing box.	See item 11.
26. Mechanical defects.	See item 18.
27. Vortex at suction inlet.	See item 20.
28. Obstruction in liquid passages.	Check to see if suction and discharge valves are fully open. Dismantle pump and inspect passages and casing. Remove obstruction.
29. Air or gases in liquid.	May be possible to over rate pump to a point where it will provide adequate pressure despite condition. Better provide gas separation chamber on suction line near pump and periodically exhaust accumulated gas. See item 17.

TROUBLE SHOOTING (CONT.)

CAUSES	CURES
Pump Operates For Short Time, Then Stops	
30. Insufficient NPSHA.	See item 17.
31. System head too high.	See items 4 and 10.
Pump Takes Too Much Power	
32. Head lower than rating; thereby pumping too much liquid.	Machine impeller's O.D. to size advised by factory or reduce speed.
33. Cavitation	See item 17.
34. Mechanical defects.	See items 18, 19, 21, and 23.
35. Suction inlet not immersed.	See item 20.
36. Liquid heavier (in either viscosity or specific gravity) than allowed for.	Use larger driver. Consult factory for recommended size. Test liquid for viscosity and specific gravity.
37. Wrong direction of rotation.	See item 6.
38. Stuffing box glands too tight.	Release gland pressure. Tighten reasonably. If sealing liquid does not flow while pump operates, replace packing.
39. Casing distorted by excessive strains from suction or discharge piping.	Check alignment. Examine pump for rubbing between impeller and casing. Replace damaged parts. Repipe pump.
40. Shaft bent due to damage – through shipment, operation, or overhaul.	Check deflection of rotor by turning on bearing journals. Total indicator run-out should not exceed .002" on shaft and .004" on impeller wearing surface.
41. Mechanical failure of critical pump parts.	Check wear rings and impeller for damage. Any irregularity in these parts will cause a drag on shaft.
42. Misalignment.	Realign pump and driver.
43. Speed may be too high.	Check voltage on motor. Check speed versus pump nameplate rating.
44. Electrical defects.	The voltage and frequency of the electrical current may be lower than that for this motor was built, or there may be defects in motor. The motor may not be ventilated properly due to a poor location.
45. Mechanical defects in turbine, engine or other type of drive exclusive of motor.	If trouble cannot be located, consult factory.

CHANGING ROTATION

⚠ WARNING: Rotating Components Hazard

Do not operate pump without all guards in place. Failure to follow these instructions could result in serious personal injury or death and property damage.

8200 Series centrifugal pumps can be operated clockwise or counterclockwise when viewed from the coupling end of the pump. If you wish to reverse the suction and discharge nozzles; i.e., change rotation, this can be accomplished with the same pump as follows:

1. Remove the impeller from the shaft, and relocate the two impellers per Figure 10 for the desired rotation. (Follow the disassembly procedures given in this manual.)
2. With the rotating element out of the casing, remove the casing from the base and turn 180°. (Factory bases are drilled for both rotations.)
3. Set the rotating element back in the casing and reassemble the pump.

NOTE: The impeller and casing are in the same relationship to each other as they were originally. The shaft and motor are also in the same relationship to each other as they were originally. The suction and discharge are offset, so the piping will need to be changed to accommodate the new flange locations.

4. Reassemble the pump and realign the coupling as called for in the alignment instructions.
5. The rotation of the motor must be changed by switching the motor leads.

NOTE: Unless the motor rotation is reversed the impeller will run backward.

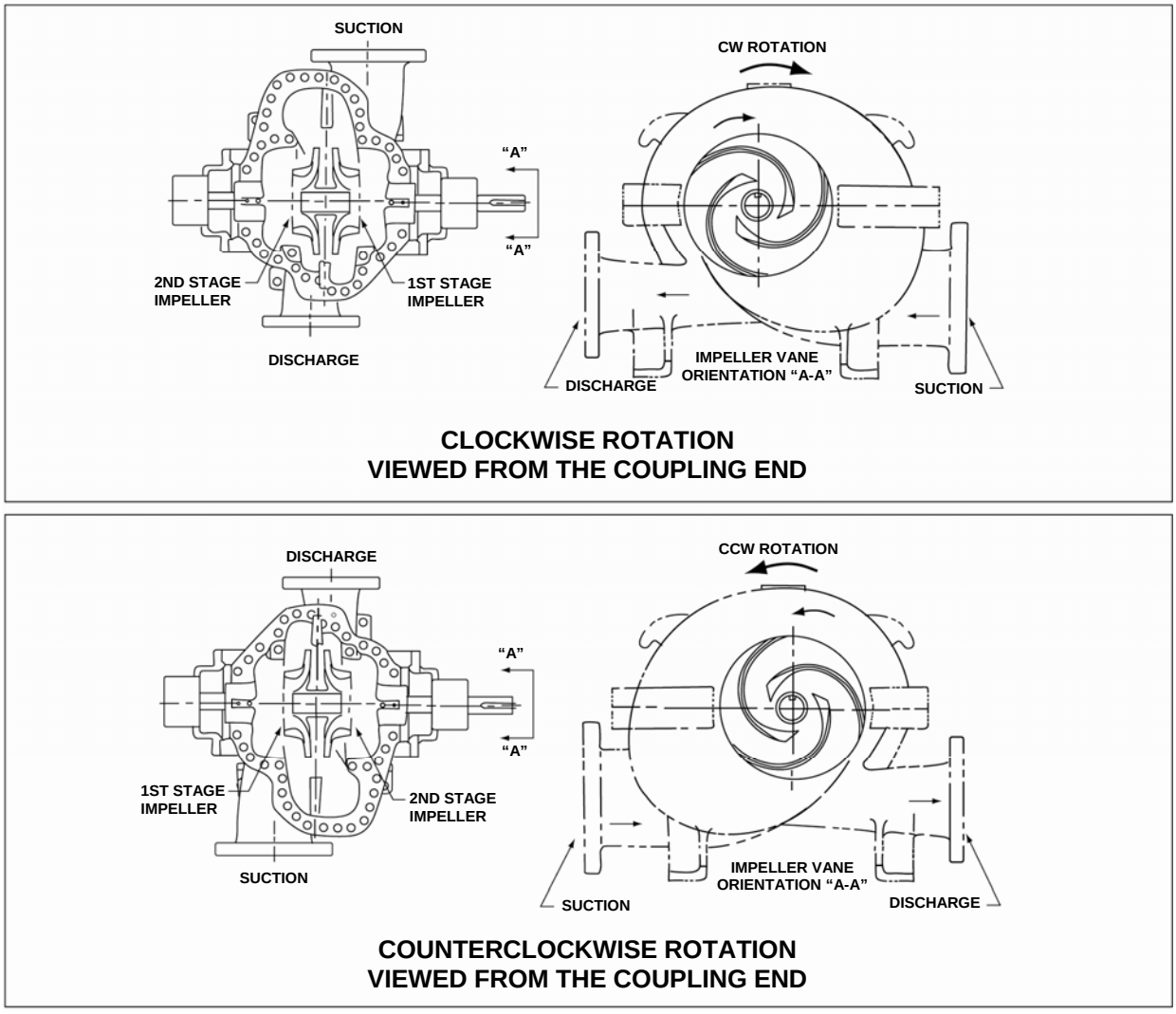


FIGURE 10 – CORRECT RELATIONSHIP OF THE IMPELLERS AND CASING

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY PROCEDURES

The procedures outlined in this section cover the dismantling and reassembly of the 8200 Series Centrifugal Fire Pumps.

When working on the pump, use accepted mechanical practices to avoid unnecessary damage to parts. Check clearances and conditions of parts when pump is dismantled and replace if necessary. Steps should usually be taken to restore impeller and casing ring clearance when it exceeds three times the original clearance.

DISMANTLING (PUMP WITH PACKING)

WARNING: Unexpected Startup Hazard
Disconnect and lockout power before servicing. Failure to follow these instructions could result in serious personal injury or death, or property damage.

WARNING: Electrical Shock Hazard
Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances, and good practices. Failure to follow these instructions could result in serious personal injury or death, or property damage.

WARNING:
Prior to working on pump the power source should be disconnected with lockout provisions so power cannot be re-energized to the motor. Close isolating suction and discharge valves. Failure to follow these instructions could result in property damage, severe personal injury, or death.

CAUTION: Extreme Temperature Hazard
Allow pump temperatures to reach acceptable levels before proceeding. Open drain valve, do not proceed until liquid stops coming out of drain valve. If liquid does not stop flowing from drain valve, isolation valves are not sealing and should be repaired before proceeding. After liquid stops flowing from drain valve, leave valve open and continue. Remove the drain plug located on the bottom of the pump housing. Do not reinstall plug or close drain valve until reassembly is completed. Failure to follow these instructions could result in property damage and/or moderate personal injury.

1. Drain pump by opening vent plug (2-910-9) and removing drain plugs (2-910-9) on suction and discharge nozzle. (See Exploded View on page 33).
2. Remove coupling guard and separate the coupling to disconnect the pump form the driver.
3. Remove seal lines (1-952-0).
4. Remove gland bolts (1-904-9), washers (1-909-9), and gland (1-014-9) from each stuffing box.
5. Remove all casing main joint cap screws (2-904-1) and dowels (2-916-0). Use slot in casing main joint and separate the casing halves with a pry bar. Lift upper half casing (2-001-7) by castlugs.

NOTE: Casings have jacking screws.

6. Remove packing (1-924-9) and seal cage (1-013-9) from each stuffing box.
7. Remove cap screws (3-904-9) which hold bearing housings (3-025-3) to the casing and lift rotating element out of lower casing (2-001-8). Rotating element may now be moved to suitable working location.
8. Pull coupling half and key (3-911-2) off shaft (3-007-0).

NOTE: A spare rotating element can be installed at this point.

9. Remove cap screws (5-904-9) from bearing covers (5-018-0).
10. Remove bearing housings (3-025-3), locknut (3-516-4), and lockwasher (3-517-4). Mount bearing puller and remove bearings (3-026-2). Remove retaining collar and split ring on outboard side and snap ring on inboard side.

CAUTION:
DO NOT REUSE THE BALL BEARINGS. Failure to follow these instructions could result in injury or property damage.

NOTE: Locknut and lockwasher are not used on inboard end bearing.

11. Remove bearing covers (5-018-0) and push oil seals (3-177-9) out of bearing covers. Pull deflectors (3-136-9) off shaft. Slide stuff box bushings (6-008-0) off of shaft.

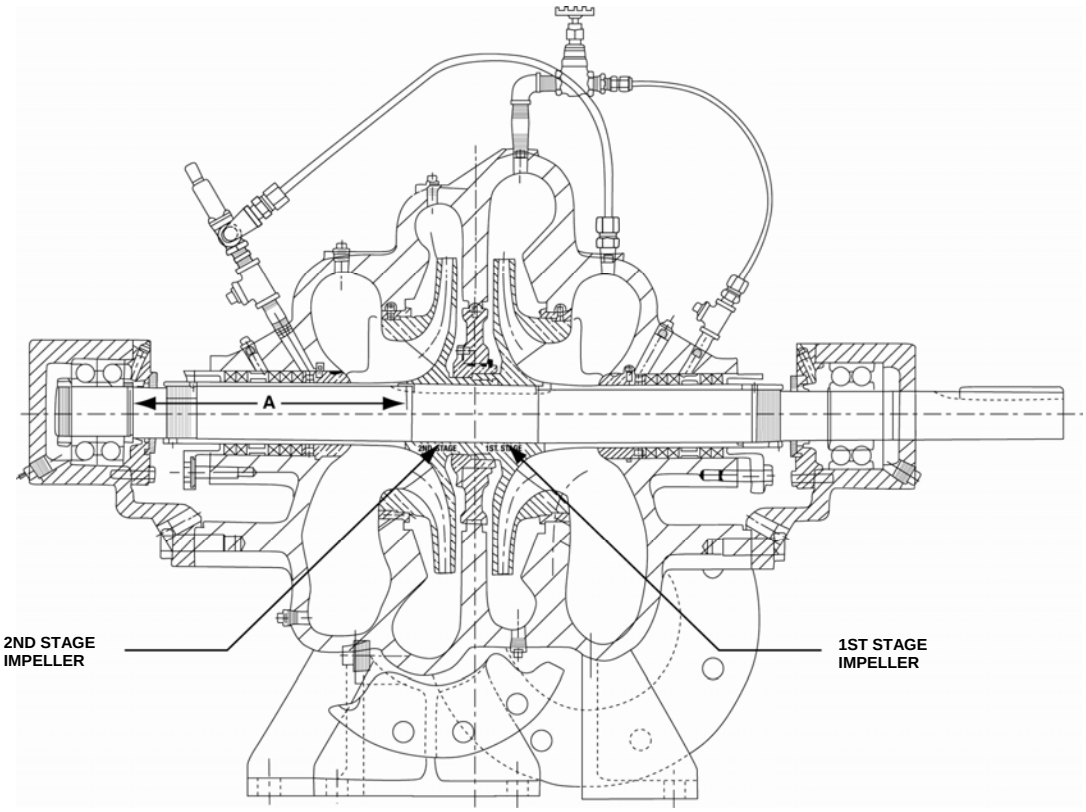
12. Remove casing rings (3-003-9) from impeller (4-002-0).

13. Remove set screw (3-902-9) from shaft nuts. Remove shaft nuts (3-015-9), O-rings (3-914-9), sleeves (3-009-9), interstage bushing (3-231-0), and impellers (4-002-0).

NOTE: Apply heat uniformly to the shaft sleeve to loosen the sealant between the shaft and sleeve.

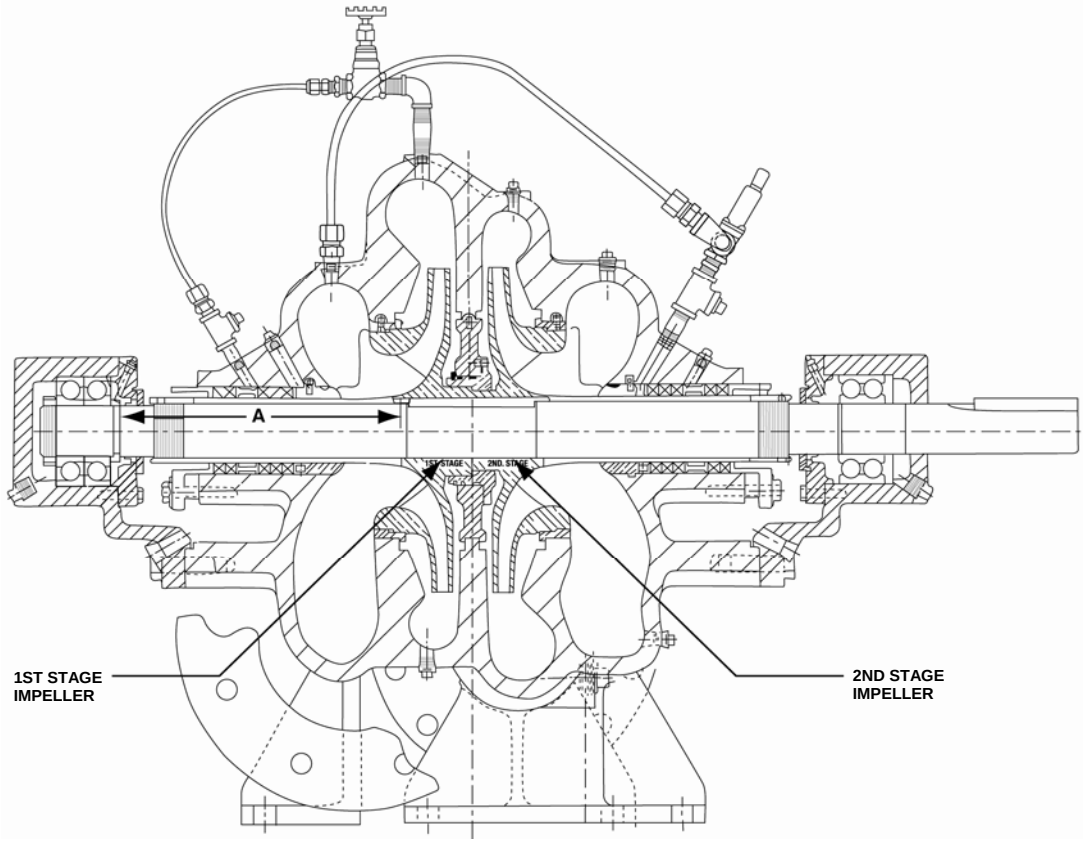
CAUTION:
DO NOT EXCEED 275°F. Failure to follow these instructions could result in injury or property damage.

To further assist in removing the sleeves, hold the shaft vertically and drop it on a block of wood. The impeller weight should force both the impellers and sleeves from the shaft.



Dimension "A" = 12.06"

FIGURE 11 – ASSEMBLY SECTION: PUMP WITH PACKING CLOCKWISE ROTATION



Dimension "A" = 12.06"

FIGURE 12 – ASSEMBLY SECTION: PUMP WITH PACKING COUNTER-CLOCKWISE ROTATION

ASSEMBLY (PUMP WITH PACKING)

All bearings, O-rings, seals, gaskets, impeller rings, and casing wear rings should be replaced with new parts during assembly. All reusable parts should be cleaned of all foreign matter before reassembling. The main casing joint gasket can be made using the upper or lower half as a template. Lay the gasket material on the casing joint and mark it by pressing it against the edges of the casing. Trim the gasket so that it is flush with the inside edges of the casing.

NOTE: Precut casing gaskets (2-153-5, -6) can be ordered to minimize the amount of trimming.

1. Place impeller key (3-911-1) in shaft (3-007-0).
2. Identify the first and second stage impellers (4-002-0) by the cast label. For clockwise rotation, locate the second stage impeller on the shaft per Figure 11 dimension 'A'. For counter-clockwise rotation, locate the first stage impeller per Figure 12 dimension 'A'.
3. Pre-assemble interstage bushing (3-034-0) and diaphragm (3-231-0) assembly as follows:
   a) Install O-rings (3-914-7, -8) in the three grooves on the interstage bushing.
   b) Lightly press the bushing into the diaphragm, locating the hole in the bushing over the pin in the diaphragm. Install snap ring (3-915-0) to secure assembly.
4. Slide interstage busing assembly over shaft and place over the rear hub of the impeller.
5. Place the other impeller on the shaft and slide under the interstage bushing until it touches the impeller already installed. Verify dimension 'A' is maintained. See Figure 11 or 12.
6. Apply RTV (Dow Corning Silicone Sealant or equivalent) uniformly about shaft sleeve (3-009-9) inside diameter, covering an area of about 1/2 inch at each impeller end of sleeve. Also, apply sealant to the face of the impellers.
7. Slide shaft sleeves onto shaft, rotating the sleeves to evenly distribute the sealant applied in above step. Rotate until pin in sleeve engages into keyway of impellers and push sleeves against impeller face until the sleeve is flush against the face. Wipe off any excess sealant.
8. Place the sleeve O-ring (3-914-9) onto shaft and place in sleeve counterbore. Verify that dimension 'A' is maintained, then using a pin spanner wrench and hammer, securely tighten the shaft sleeve nuts (3-015-9). Drill a shallow recess in the shaft through the set screw hole in each of the shaft sleeve nuts. Stake each shaft sleeve nut in position with cup point set screws (3-902-9).
9. Slide casing rings (3-003-9) onto the impellers.
10. Place two O-rings (6-914-9) on each stuffbox bushing (6-008-0), then slide over shaft sleeve with the beveled end facing the impeller.
11. Start heating bearings (3-026-3, -4) so they will be ready to use in a later step. Use dry heat from induction heat lamps or electric furnace, or a 10 - 15% soluble oil and water solution.

CAUTION:
DO NOT EXCEED 275°F. Failure to follow these instructions could result in injury or property damage.

CAUTION:
These are precision, high quality bearings. Exercise care at all times to keep them clean and free from foreign matter. Failure to follow these instructions could result in injury or property damage.

12. Assemble lip seal (3-177-9) in each bearing cap (5-018-0). Seal lip or pressure side of seal must point away from the end of the shaft the lip seal is assembled on.
13. Slide deflectors (3-136-9) and bearing caps on the shaft. Install snap ring (5-915-3) on the inboard side of shaft. Install the split ring (5-050-4) and retaining collar (5-421-4) on the outboard side of shaft.
14. Using gloves, install the double row ball bearing on the inboard side and locate against snap ring.
15. Using gloves, install the two angular contact bearings on the outboard end of shaft. These bearings must be installed "back to back" (wide shoulders of outer race contacting, as shown on assembly section).

a) Remove the preservative from the outside diameter and faces of the bearings. Heat both bearings to 200°F at the same time. Place the first bearing on the shaft. Very quickly place the second bearing on the shaft. When installing the second bearing, push against the inner race to remove all clearance between the inner races of the two bearings, and between the inner race of the first bearing and the retaining collar.

b) Use locknut (3-516-4) to hold the bearings together against the retaining ring while they cool. First, place the bearing lockwasher (3-517-4) on the shaft with the locking tabs away from bearing. Install the locknut with the beveled edge facing the bearing. Tighten it as much as possible with a spanner wrench turned by hand.

c) After the bearings have cooled to room temperature, retighten the locknut as much as possible with a spanner wrench turned by hand. Then use a hammer on the wrench to tighten the locknut an additional eighth to quarter turn. Be sure a slot on the nut lines up with a tab on the lockwasher. Bend one of the lockwasher tabs into matching slot on the bearing locknut.

16. Once bearings are cooled to room temperature, coat with 2 to 3 ounces of a recommended grease.

17. Slide bearing housings (3-025-3, -4) onto shaft over bearings.

18. Assemble bearing caps to bearing housings using cap screws (5-904-9).

NOTE: These are grade 8 screws.

19. Assemble pipe plugs (2-910-9) and grease fittings (5-905-9) as required.

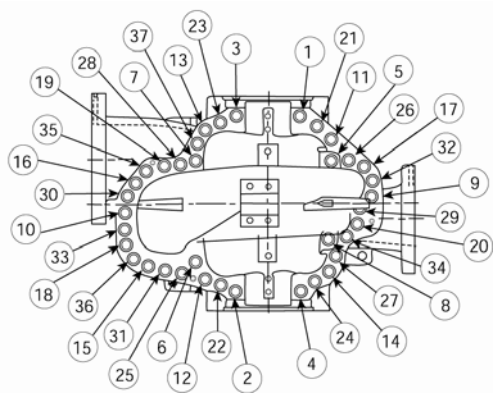
20. Replace pump coupling half and key.

21. Clean gasket surfaces of the casing. Apply Scotch 3M-77 spray adhesive or equivalent to the lower half of the casing. (2-001-8).

22. Within one minute of spraying, set the untrimmed gaskets (2-123-5 and -6) in place on the lower half casing, align the holes in the gaskets with the holes in the casing and press the gaskets firmly against the lower half casing face in the area coated by the adhesive.

23. Trim the gaskets flush with the lower casing bores, if this has not been done yet.

CAUTION:
Machined casing bores must remain sharp at the casing parting line. Gaskets must be flush with bore in order to contact O-rings. Leakage can result around stuff box O-ring if this step is not properly followed. Failure to follow these instructions could result in injury or property damage.



350 FT.LBS MIN. TORQUE REQUIRED

FIGURE 13 – TORQUE PATTERN FOR CASING MAIN JOINT

24. Assemble rotating element in lower half casing. Correctly locate casing ring pins, stuff box bushing pins, and interstage diaphragm pins in casing main joint slots. Sliding the inboard bearing housing towards the coupling slightly will ease assembly.

25. Bolt outboard bearing housing in place. Be sure that both housings are seated properly in lower half casing.

26. Bolt inboard bearing housing in place. Rotating element should now turn freely.

CAUTION:
Double check rotation of pump before installing the upper half casing. Failure to follow these instructions could result in injury or property damage.

27. Lower the upper half casing (2-001-7) into place, locate using the dowels (2-916-0), and install casing main joint bolts (2-904-1). The casing joint bolts should be tightened to the torque specified in Figure 16.

NOTE: Torque values are essential in obtaining proper gasket compression so no leakage can occur at main joint.

28. Slide deflectors toward bearing covers. Allow rotating clearance of approximately 1/16".

29. Rotate shaft by hand to assure that it turns smoothly and is free from rubbing and binding.

30. Cut full rings packing (1-924-9) so that ends butt, leaving no gap between packing and casing. Install three rings of packing and tap fully to bottom of both stuffing boxes. Stagger joints of each ring of packing at least 90°. Install seal cage (1-013-9) and be sure that it will line up with seal water inlet when packing is compressed. Install remaining two rings of packing with joints staggered. Assemble glands (1-014-9) square with stuffing box and pull up tight. Then loosen gland bolts (1-904-9) to permit packing to expand, and retighten finger tight. Final adjustment of gland bolts must be done when pump is running. Allow 30 minutes between adjustments.

31. Assemble seal water flush and bleed lines (1-952-0).

    a) Clockwise – Figure 11

    b) Counter-clockwise – Figure 12

32. Check coupling alignment and realign if necessary.

APPENDIX "A" ENGINEERING DATA

Pump Size A	8x6x14F-S 8200	H8x6x14F-S 8200	8x6x14F-L 8200	H8x6x14F-L 8200	8x6x18 8200	H8x6x18 8200
Number of Stages	2	2	2	2	2	2
Approval Flow Rate (GPM)	500/750 /1000	500/750 /1000	500/750 /1000	500/750 /1000	500/750 /1000	500/750 /1000

CASING DATA

(All Dimensions in Inches)

Flange Rating ASA Standard	Suction	125 or 250	125 or 250	125 or 250	125 or 250	125	250
	Discharge	250	800	250	800	250	250
Casing Material		*Cast Iron ASTM A48 Class 35*	*Ductile Iron ASTM A536 Gr. 65-45-12*	*Cast Iron ASTM A48 Class 35*	*Ductile Iron ASTM A536 Gr. 65-45-12*	*Cast Iron ASTM A48 Class 35*	*Ductile Iron ASTM A536 Gr. 65-45-12*
Max. Working Pressure (PSIG)		500	800	500	800	375	500
Max. Suction Pressure (PSIG)		100	300	100	300	100	200
Max. Hydrostatic Pressure (PSIG)		750	1200	750	1200	563	750
Standard Hydrostatic Test Pressure (PSIG)		625	1000	625	1000	468	625
Casing Wall Thickness		.75	.75	.75	.75	.75	.75

STUFFING BOX DATA

(All Dimensions in Inches)

Bore	3.75	3.75	3.75	3.75	3.75	3.75
Depth	4.06	4.06	4.06	4.06	4.06	4.06
Packing: No. Rings/Size Square	5/.50	5/.50	5/.50	5/.50	5/.50	5/.50
Seal Cage Width	.94	.94	.94	.94	.94	.94
Shaft Sleeve O.D.	2.75	2.75	2.75	2.75	2.75	2.75

IMPELLER DESIGN DATA

(All Dimensions in Inches)

No. of Vanes	6	6	6	6	6	6
Inlet Area (Sq. Inches)	26.75	26.75	33.14	33.14	28.72	28.72
Maximum Diameter	14.0	14.0	14.0	14.0	18.0	18.0
Minimum Diameter	9.0	9.0	9.0	9.0	13.5	13.5
Maximum Sphere	.50	.50	.63	.63	.63	.63
WR for Max. Dia. (Lbs-Ft)	8.5	8.5	8.0	8.0	20.0	20.0
Wear Ring Clearance - Diametral	.015-.017	.015-.017	015-.017	015-.017	015-.017	015-.017

SHAFT AND BEARING DATA

(All Dimensions in Inches)

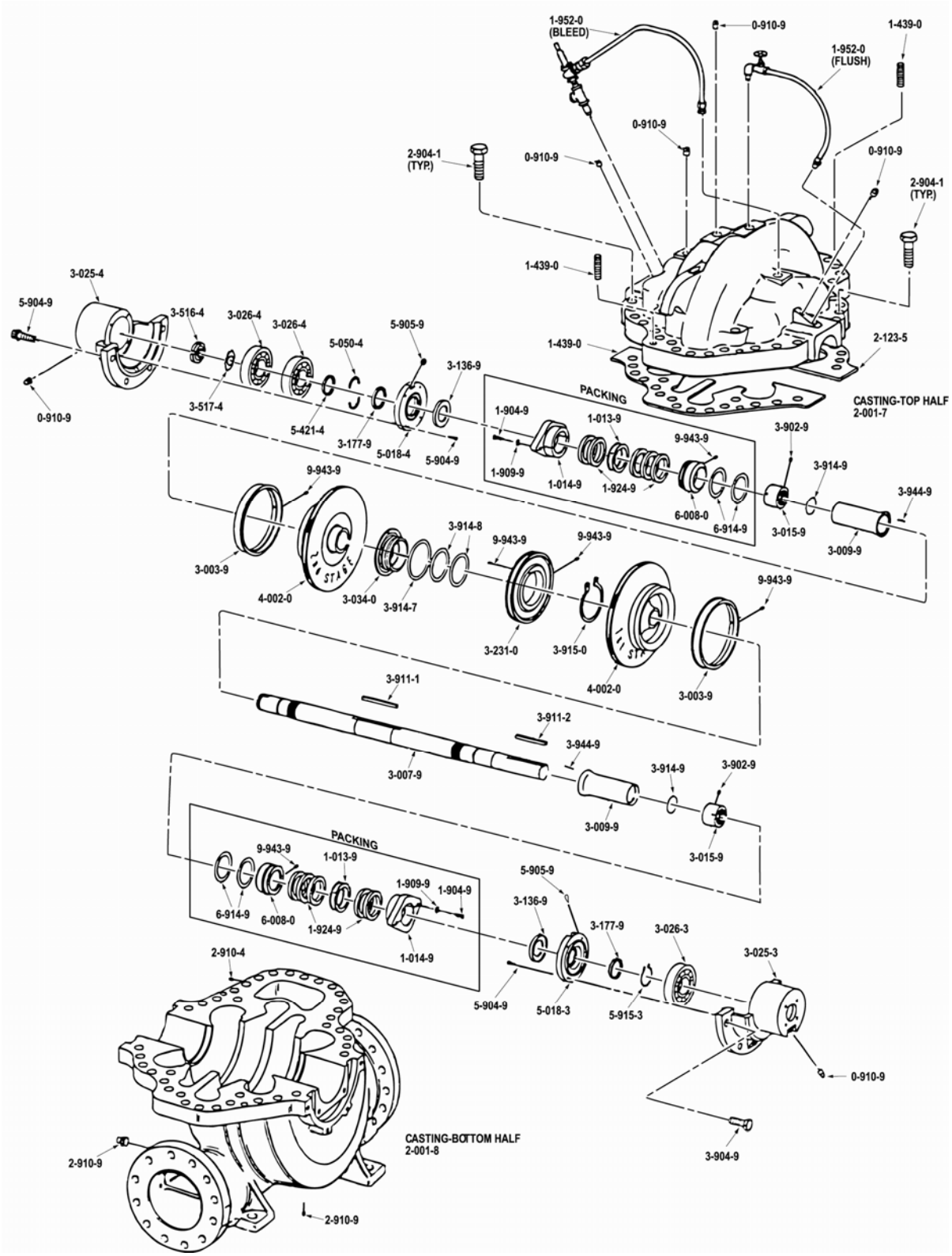
Diameter Thru Impeller		2.437	2.437	2.437	2.437	2.437	2.437
Diameter Thru Sleeve		2.375	2.375	2.375	2.375	2.375	2.375
Diameter at Coupling		2.125	2.125	2.125	2.125	2.125	2.125
Shaft Span – Brg. to Brg.		33.45	33.45	33.45	33.45	33.45	33.45
Ball Bearings	Inboard Brg. No.	5311	5311	5311	5311	5311	5311
	Dia. Thru Brg.	2.1654	2.1654	2.1654	2.1654	2.1654	2.1654
	Outboard Brg. No.	7311 BG (2)	7311 BG (2)	7311 BG (2)	7311 BG (2)	7311 BG (2)	7311 BG (2)
	Dia. Thru Brg.	2.1654	2.1654	2.1654	2.1654	2.1654	2.1654
Frame Number		F27-A1	F27-A1	F27-A1	F27-A1	F27-A1	F27-A1
Instruction Book Number		AC2675	AC2675	AC2675	AC2675	AC2675	AC2675

A (H) Prefix indicates High Pressure Casing

APPENDIX “B”

EXPLODED VIEW – 8200 SERIES FIRE PUMP

CLOCKWISE ROTATION



APPENDIX "B"

REPLACEMENT PARTS LIST

Part Number	Part Name	Quantity
1-952-0	Bleed Line	1
1-952-0	Flush Line	1
0-910-9	Pipe Plug	14
1-013-9	Seal Cage	2
1-014-9	Gland	2
1-901-9	Gland Bolt	4
1-909-9	Washer, Gland Bolt	4
1-924-9	Packing Ring	10
2-001-7	Casing, Upper Half	1
2-001-8	Casing, Lower Half	1
2-123-5	Casing Joint Gasket (Suction)	1
2-123-5	Casing Joint Gasket (Discharge)	1
2-904-1	Cap Screw (Casing)	Varies with size
1-439-0	Dowel	2
3-003-9	Casing Ring	2
3-007-0	Shaft	1
3-009-9	Shaft Sleeve	2
3-015-9	Shaft Sleeve Nut	2
5-018-0	Bearing Housing Cover	2
3-025-3	Bearing Housing	1
3-026-3	Bearing, Inboard	1
3-026-4	Bearing, Outboard	2
5-050-4	Split Ring	1
5-421-4	Retaining Collar	1
3-169-9	Deflector	2
3-177-9	Lip Seal	2
3-516-4	Locknut	1
3-514-4	Lockwasher	1
3-902-9	Set Screw	2
5-904-9	Bearing Cover Bolt	8
3-911-1	Key (Impeller)	1
3-911-2	Key (Coupling)	1
3-914-9	O-Ring (Shaft Sleeve)	2
6-914-9	O-Ring (Stuffbox Bushing)	4
6-008-0	Stuffbox Bushing	2
3-034-0	Interstage Bushing	1
3-231-0	Interstage Diaphragm	1
3-914-7	O-Ring (Interstage Bushing)	3
5-915-0	Snap Ring (Bearing)	1
3-915-0	Snap Ring (Interstage Bushing)	1
4-002-0	Impeller	2

APPENDIX “B”

INSTRUCTIONS FOR ORDERING PARTS

When ordering parts for 8200 Series Fire Pumps, be sure to furnish the following information to the ITT A-C Fire Pump Systems stocking distributor in your area:

- Serial Number
- Pump Size & Type
- Pump Model Number
- Pump Frame Number
- Description of Part
- Catalog Code
- Quantity Required
- Definite Billing and Shipping Instructions
- Date Required

Refer to parts list on page 34 for a complete parts list and recommended spare parts.

Parts should be ordered as far in advance of their need as possible, since circumstances beyond the control of ITT A-C Fire Pump Systems may reduce existing stock. All parts are not carried in stock. Some are made for each order. If replacement parts required are to be made of different materials than originally specified, give exact requirements and the reason for changing. Special care in furnishing the above information with the original order for parts will facilitate shipment.

Field Test Report

Date _____

Pump Size _____ Pump Type _____ RATING: GPM _____ Head _____ RPM _____

Pump Serial No. _____ Imp. Dia. (in.) _____ Suction gage connection pipe size _____ in.

Manufacturer's Pump Curve No. _____ Discharge gage connection pipe size _____ in.

Discharge gage elevation corr. _____ ft.

Suction gage elevation corr. _____ ft.

MOTOR:** Rated HP _____ Volts _____ S.F. _____ Barometric pressure _____ in. Hg x 1.13 = _____ ft. water

F. L. Amps _____ F.L. Eff. _____ P.F. _____ Liquid pumped _____ S.G. _____

Phase _____ Liquid temperature _____ °F

Liquid vapor pressure _____ psi x 2.31 = _____ ft. water

POINT	Disch. Press. Gage (psi)	Disch. Press. Gage (ft.)	Suct. Press. Gage (psi)	Suct. Press. Gage (ft.)	Velocity Head (ft.) Disc.	Velocity Head (ft.) Suct.	Total Dynamic Head (TDH_2)	Flow Reading	Flow Convert to GPM_2	RPM_2	Motor Volts	Motor Amps leg 1	Motor Amps leg 2	Motor Amps leg 3	Avg. Amps.	Pump BHP_2 (calc'd)	Pump Eff (calc'd)	Affinity Law Corrections RPM_1	Affinity Law Corrections TDH_1	Affinity Law Corrections GPM_1	Affinity Law Corrections BHP_1	Calc'd NPSHA	NPSHR*
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							

*NPSHR taken from manufacturer's price book curve.
**Motor information taken off motor nameplate.
See sheet 2 of 2 for useful formulas.

Type of flow measurement device: _____

Readings taken by: _____

Comments: _____

_____

1 of 2

APPENDIX "C" FIELD TEST REPORT

USEFUL FORMULAS

1) Head (ft.) = $\frac{\text{Pressure (psig.) x 2.31}}{\text{S.G.}}$ S.G. = specific gravity; S.G. of water = 1.0 at 70°F

2) TDH (ft.) = Total Dynamic Head (ft.) = (Disch. pressure gauge reading - Suct. pressure gauge reading) + (Discharge velocity head - Suction velocity head) + (Elevation correction to disch. gauge - Elevation correction to suct. gauge)

3) PUMP INPUT HP (BHP) - calculated:

Single Phase Motor

$$BHP = \frac{\text{Amps x Volts x } n_m \text{ x p.f.}}{746}$$

Three Phase Motor

$$BHP = \frac{\text{Avg. Amps x Volts x 1.732 x } n_m \text{ x p.f.}}{746}$$

where n_m = motor efficiency, p.f. = motor power factor, Avg. Amps = $\frac{\text{leg 1} + \text{leg 2} + \text{leg 3}}{3}$

4) Pump Efficiency (n_p):

$$n_p = \frac{\text{GPM x TDH}}{\text{3960 x BHP}}$$

5) Affinity Laws for correcting GPM, TDH, and BHP for speed (RPM):

$$\frac{GPM_1}{GPM_2} = \frac{RPM_1}{RPM_2} \quad \text{or} \quad GPM_1 = GPM^2 \times \frac{RPM_1}{RPM_2}$$

$$\frac{TDH_1}{TDH_2} = \left(\frac{RPM_1}{RPM_2}\right)^2 \quad \text{or} \quad TDH_1 = TDH^2 \times \left(\frac{RPM_1}{RPM_2}\right)^2$$

$$\frac{BHP_1}{BHP_2} = \left(\frac{RPM_1}{RPM_2}\right)^3 \quad \text{or} \quad BHP_1 = BHP^2 \times \left(\frac{RPM_1}{RPM_2}\right)^3$$

6) NPSHA DETERMINATION:

NPSHA = Net Positive Suction Head Available

NPSHA = (Atmospheric pressure - Vapor pressure of liquid + Total suction head)

Total Suction Head = (Suction pressure gauge reading + Suction velocity head + Elevation correction to suction gauge)

NOTE: NPSHA must always be greater than NPSHR (NPSHA ≥ NPSHR) for the pump to operate without concern of cavitation.

NPSHR refers to Net Positive Suction Head Required by pump. This is a published value obtained from the Pump Manufacturer's curve.

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